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VOL. 10 NO. 8 MAY 1988

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CONTENTS

			PAGE
FIRST WORD	Big Brother's Society	Ira Glasser	8
OMNIBUS	Data Bank		10
COMMUNICATIONS	Correspondence		12
FORUM	Nuclear-Free Zones	Gregg Levoy	14
EARTH	Conservation Views of the Presidential Candidates	Cathy Spencer	18
ARTIFICIAL INTELLIGENCE	Stolen Sounds	Robert Neumann	20
SPACE	The Women of NASA	Lindsy Van Gelder	24
BODY	Remote-Controlled Surgery	Richard Wolkomir	28
CONTINUUM	The Politics of Immortality, etc.		31
NUCLEAR REACTIONS	Future Energy	Joel Davis	40
LIFE OF BUDDHA	Fiction	Lucius Shepard	52
SPIRIT DWELLINGS	Mystical Architecture	Jamake Highwater	64
MIXED MARRIAGES	Pictorial: Claude Verlinde's Fantasy Art	Nina Guccione	76
INTERVIEW	John Bell, Particle Physicist	Charles Mann and Robert Crease	84
BOUND FOR GLORY	Pictorial: Mummies	Nina Guccione	94
THE GIRL WHO LOVED ANIMALS	Fiction	Bruce McAllister	100
ANTIMATTER	Mysterious Men in Black, etc.		107
MIND	Rhythm and Wombs	Bibi Wein	122
STAR TECH	Superantennas, Seasickproof Boats, and Other Tools for the Year 2000		136
GAMES	Eccentric Inventors, plus Crossword Puzzle Results	Scot Morris	140
LAST WORD	Humor: Bad Apples	Kathy Thornock	142

Part of the permanent collection of the Hiroshima Museum of Modern Art, the photo on this month's cover was shot by New York-based photographer Kan to commemorate the fortieth anniversary of the bombing of Hiroshima.

OMNI (ISSN 0149-8711) is published monthly in the United States and Canada by Omni Publications International Ltd., 1965 Broadway, New York, NY 10023-5965. Second-class postage paid at New York, NY, and at additional mailing offices. POSTMASTER: Send address changes to Omni Magazine, Post Office Box 3041, Harlan, IA 51593-4256. Volume 10, Number 8.

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Subscriptions: U.S., AFO—$24 one year; Canada and elsewhere—$28 one year. Single copies $3.00 in U.S., AFO, and Canada. Telephone: 1-800-289-6664.

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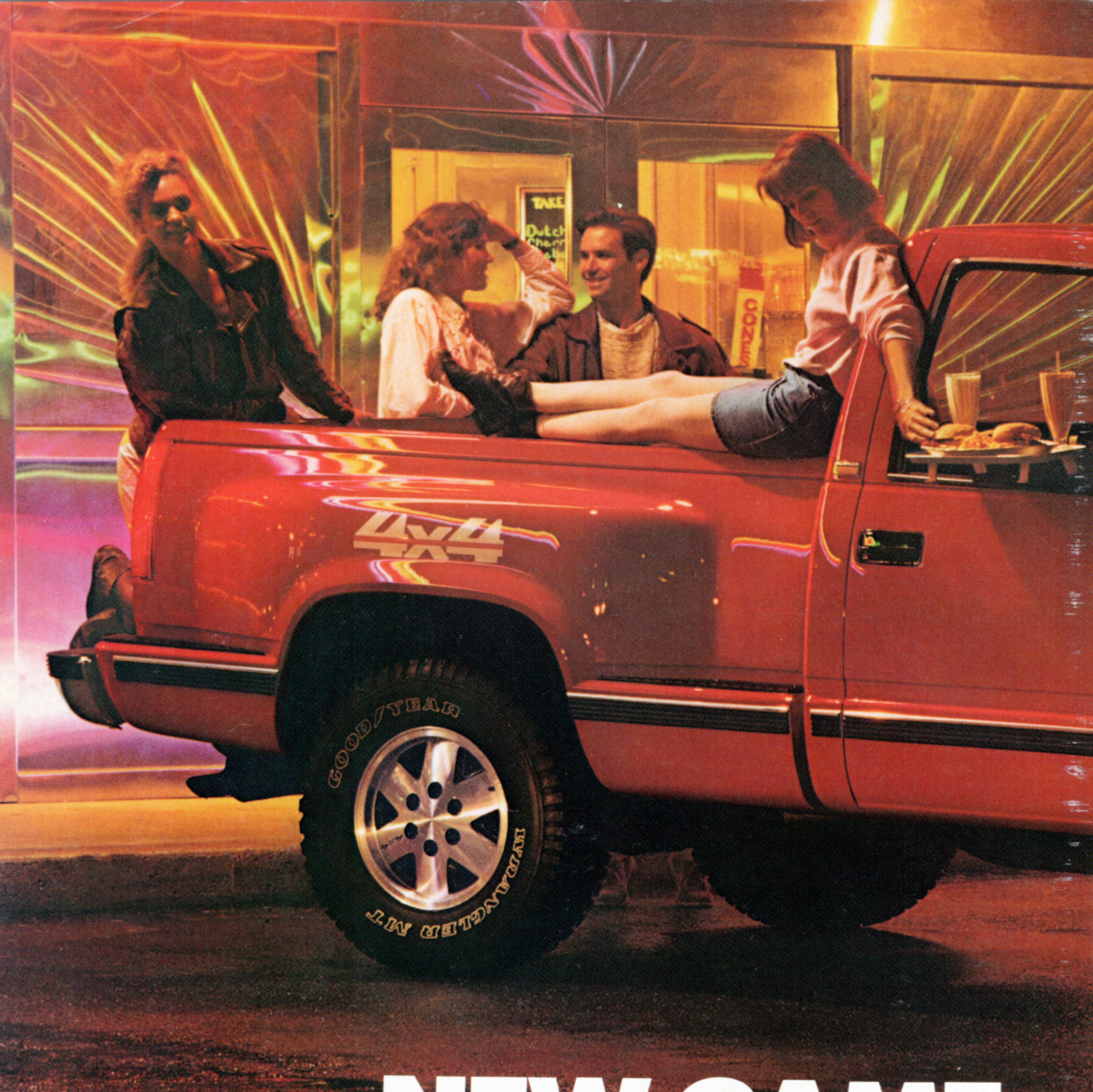

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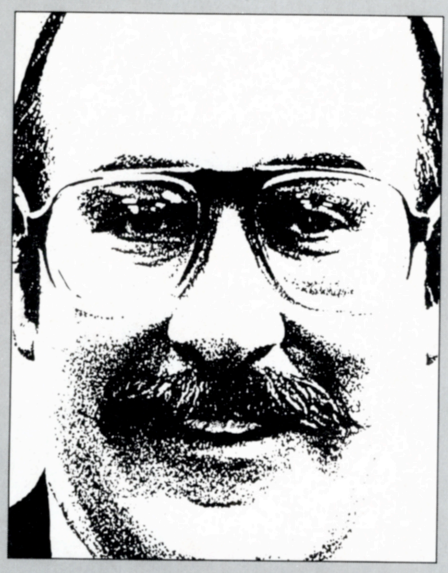


FIRST WORD

By Ira Glasser

"The real question is, Do we really want to give employers the ability to monitor an employee's life-style? As one federal judge put it, "It is George Orwell's Big Brother society come to life."

On March 3, 1986, the President's Commission on Organized Crime proposed that all employees of the federal government be tested periodically for drugs as a condition of employment. This call was the opening gambit for what was to be a phenomenal increase in workplace drug testing, especially in the private sector. It is estimated that about 80 percent of the nation's largest corporations now subject either job applicants or current employees to urinalysis as a condition of employment.

I believe it is unfair to force millions of American workers who are not even suspected of using drugs to submit to humiliating and intrusive urine tests. More important, it is inconsistent with our basic democratic principles. Bob Stanley, a pitcher for the Boston Red Sox, put it pungently: "I don't take drugs, and I don't believe I have to piss in a bottle to prove I don't." Stanley was echoing one of the oldest American traditions—that general searches of innocent people are unfair and unreasonable. That's not just common wisdom; it's a basic principle found in the Fourth Amendment of the Bill of Rights.

Besides, urine-screening tests are far from reliable. For instance, eating poppy-seed bagels can produce a positive result for heroin. Using nasal decongestants can be confused with amphetamine use. Anti-inflammatory drugs can show up as marijuana. Even enzymes, naturally produced by the body, can interfere with the accuracy of the urine test.

The laboratories throughout the United States that analyze urine don't have the capacity to absorb millions of these tests on a routine basis without sacrificing quality and reliability. In a recent National Institute on Drug Abuse survey of medical-lab proficiency, 20 percent of the labs mistakenly reported the presence of illegal drugs in drug-free urine samples.

Even if drug tests were 100 percent reliable, I would still strongly oppose routine and indiscriminate drug testing in the workplace without individualized suspicion. First of all, drug tests are commonly a surveillance device for off-the-job activity—what people did the night or weekend before—not a test for job performance. Urine tests detect only inactive remnants of substances called metabolites. These tests are incapable of measuring current impairment or even of telling how much of a particular substance was ingested or when.

In the case of marijuana—used recreationally in the United States by 40 million people—its metabolite, tetrahydrocannabinol, lingers in the body for days and even weeks. An employee can be penalized for testing positive for marijuana that he or she smoked over the weekend or while on vacation. By the time this employee is tested, the active ingredients have long ceased to have any effect on ability to function at work. But the real question is, Do we really want to give employers the ability to monitor employee life-styles? As one federal judge put it, "It is George Orwell's Big Brother society come to life."

Urinalysis can also reveal details of one's personal life irrelevant to drug consumption. An employer can determine whether an employee or job applicant is being treated for a heart condition, depression, epilepsy, or asthma. The District of Columbia Police Department has been subjecting the urine samples of women job applicants—collected for drug tests—to pregnancy tests without the knowledge or consent of the women. Those who tested positive were not hired immediately but were "deferred" until the completion of their pregnancies. That is more than a probable violation of federal antidiscrimination laws; it is an intrusion into people's private lives.

When employers assume the right to make employees take a drug test, it is not only to detect a medical condition. These tests have sometimes been a pretext for political harassment and firing. The American Civil Liberties Union (ACLU) is currently representing several safety inspectors from a nuclear power plant who, after complaining to the Nuclear Regulatory Commission about problems at the plant, were ordered by their employers to submit to drug tests. All were fired for failing the test. There had been no complaints about their performances.

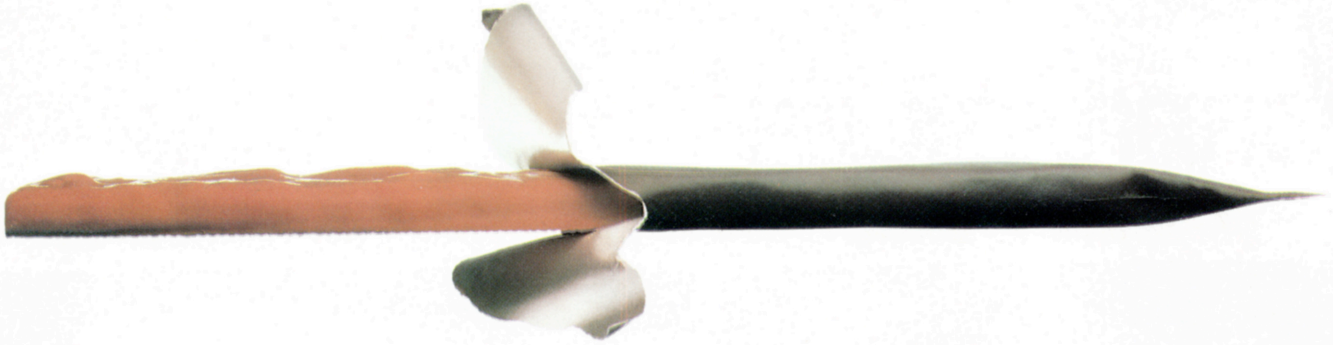
Permitting the employer to mandate urine tests without any evidence that an individual is using drugs in a way that impairs job performance invites the use of such screening to punish or silence employees with grievances.

Labor unions and civil liberties organizations, including the ACLU, have often challenged these tests on behalf of public employees. Most courts have ruled that government employers cannot subject employees to drug tests unless they have "reasonable suspicion" to believe that an individual is using drugs to the detriment of his or her job performance.

In the private sector, however, the situation is very different. Although six states have enacted legislation restricting drug testing in the private workplace, most workers can be tested for using illicit substances at any time, for any reason. Everyone agrees that employers have a right to expect competence in the workplace, but drug tests do not lead to that goal.

The public should be aware that drug tests are ineffective; that urinalysis is an indignity to an individual; and that, fundamentally, these tests are constitutionally unsound. American workers do not leave their rights to privacy at the office door or factory gate. Drug testing of innocent people without cause has no place in a free society.

Ira Glasser is executive director of the American Civil Liberties Union.



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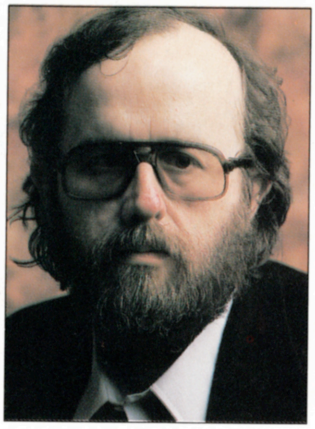

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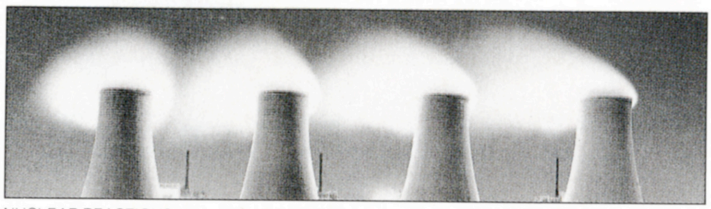

NUCLEAR REACTIONS

BOUND FOR GLORY

MIXED MARRIAGES

For nearly a decade the nuclear power industry has languished. Few, if any, new reactors have been ordered. The 1979 Three Mile Island debacle and the 1986 Chernobyl disaster, moreover, have served to increase the public's fear of nuclear power. Indeed, opponents may have expected that such accidents would further dim the prospects of nuclear reactors. Save your eulogies, though: Today nuclear power may be staging the greatest comeback since Richard Nixon's.

In "Nuclear Reactions" (page 40), *Joel Davis* reports that a core group of true believers pin their hopes and aspirations on a new generation of nuclear reactors. The design of the future, some scientists and engineers are convinced, will be simple, more efficient, and, above all, safer. And responsibility for that safety is being passed from the operators to the designers. Nuclear power as the ultimate energy source, however, depends on the industry's ability to gain public confidence. The problem is, Which reactor design—an advanced version of what we've had, or one of several radically new systems—will ultimately convert the skeptics? And will the developers be able to get it right the second time around?

While disciples preach the gospel of nuclear energy, a band of New Age architects is delving into the past to create tomorrow's sacred shrines. In "Spirit Dwellings" (page 64) *Jamake Highwater,* a noted author and the host of the PBS series *Native Land* and *Primal Mind,* re-creates his sojourn to one such temple—Colorado's Lindisfarne Mountain Retreat, where the mystical geometry of Pythagoras figures prominently. Its designers, called sacred architects, believe that shapes, room size, and the proportions of angles affect our thinking and encourage the development of consciousness. It's not enough simply to construct beautiful houses of worship, they explain, pointing out that the builders of Chartres and other great cathedrals also drew on the wisdom of the ancient Greeks.

As children, some of us were taught that our bodies are temples of God. We had to be cognizant of how we used and cared for them. Should they, then, be vessels for a higher purpose? Before answering, read "The Girl Who Loved Animals" (page 100), a story by *Bruce McAllister.* Then expect the debate to intensify after you finish *Lucius Shepard*'s "Life of Buddha" (page 52). Shepard has received critical acclaim for such works as the Nebula award-winning novella *R & R* and the novel *Life During Wartime* (Bantam Books). Now tucked away in a "low-tech Nantucket enclave with no telephone," according to his agent, Shepard's biographical data includes stints as a janitor in a nuclear facility, and a bouncer in a whorehouse in Spain. And you wonder where writers get their ideas.

Where, then, you may ask, does artist Claude Verlinde get his inspiration? We don't know, and we're afraid to ask. Nor do we have any inkling of what muse lurks in the mind of *Nina Guccione,* who spins a tale that weds her fantasies to Verlinde's in "Mixed Marriages" (page 76). Turn to page 94, and there she is again, examining Egyptian mummies, especially the 3,000-year-old singer Ta-bes, in the pictorial "Bound for Glory."

For past issues, we commissioned artist *Ron Embleton* to illustrate such subjects as dinosaurs in "Tyrannosaurus Sex: A Love Tail" (February 1988) and moon buggies in "Prix de Lune" (July 1987). Primarily a comic strip artist and painter, the fifty-seven-year-old Embleton died suddenly at his home in England in February. For nearly 40 years Embleton created meticulous and painstakingly detailed artwork for comic books like his "Gallant" series—"Gallant Science," "Gallant Adventure," "Gallant Detective," and "Gallant Western." He addressed science fiction in his adaptations of England's television puppet series, including *Stingray* and *Captain Scarlet and the Mysterons.* Embleton illustrated children's books and also created the adult cartoons "Wicked Wanda" and "Sweet Chastity." The British newspaper *The Guardian* described his works as "befitting a member of the Royal Institute of Oil Painters," to which Embleton was elected on his thirtieth birthday. Another British paper added, "In the international comic strip world Ron Embleton was a grand master of his art." It's an opinion shared by many.

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MAY

LETTERS

COMMUNICATIONS

Stars and Stripes

I admire the skill and persistence that has made Robert Evans the leader in visual supernova discovery ["Star Watch," February 1988]. The article began by describing the automated supernova-seeking observatory that started operation in 1979 but seemed to overlook, as have numerous other publications, that America is not without its own visual discoverers of supernovas. I am associated with the 1979 discovery of the M 100 supernova, and I have often wondered how it was that I found a star where high-tech, computerized telescopes failed to. And I hope to "beat the machine" again, in spite of living in a cloudy climate in the mountains of western Maryland.

Gus Johnson
Swanton, MD

Try, Try Again

With respect to Dr. Robert Kohlenberg's appeal for judicious mediocrity [Continuum, February 1988], may I offer my aphorism: If at first you don't succeed, lower your standards.

David Goldstein
New York

Pressure Point

Dr. Ji-Sheng Han [Interview, February 1988] is to be commended as a brilliant physiologist and for having the insight to draw from traditional Chinese medicine in furthering our understanding of the nervous system. Acupuncture's importance to the West, however, is not as a technology but as a complementary scientific method. Western science studies structure; Chinese science studies function. Both are useful but only over specific ranges of life's experience. Acupuncture's strength is as a medicine that can generate a diagnosis unique to each individual and not as a technology for the symptomatic relief of illness, which is Dr. Han's next project. The spirit of such a beautiful and highly evolved form of healing should not be lost in science's endless search for a quick fix.

Lonny S. Jarrett
Stockbridge, MA

Water, Water Everywhere. . .

I had recently finished reading one of the books by the late justice William Orville Douglas describing the natural beauty of America when I came across Rich Levine's article "Watergate," [Earth, February 1988]. The late justice might turn over in his grave if he knew the sad plight of our drinking water. Levine is correct when he indicates the need for rules and regulations at the state and national levels. I hope the article will put much-needed pressure on our legislators to act more aggressively in confronting this dreadful public health problem.

Leo Uzych
Wallingford, PA

As water facilities supervisor for the Du Page County Department of Public Works, it is my responsibility to maintain six separate water systems in unincorporated areas of the county. Because you have classified Du Page County under the "worst" water category, let me make clear that there are other municipalities and private water companies that own and operate water systems within the county. The other systems on your list were classified by the city they serve—not the county they are in.

Brad Jordon
Water Facilities Supervisor
Wheaton, IL

Standing Ovation

Applause, applause, and more applause for Senator Claiborne Pell [First Word, February 1988]. It is refreshing to read that someone in the U.S. Senate has had the insight to address the issue of funding for science. The need for a coherent, balanced, and long-term national science policy needs attention in Congress.

Nina C. Dowlin
Coatesville, PA

Credit Where Due

The credit for the photo at the top of page 30 in the March 1988 issue should have read: ©1986 Mark Hallett, all rights reserved. In addition, the image was reversed. Our apologies.

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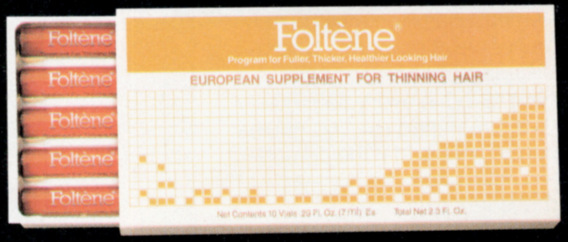

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EUROPE'S ANSWER TO THINNING HAIR.

NUKEBUSTERS

FORUM

By Gregg Levoy

Takoma Park, Maryland, a community of 17,000, passed a legally binding nuclear free zone (NFZ) ordinance in 1983, banning the city from investing in or purchasing from any company doing nuclear weapons work. The city then dropped its contracts with Motorola for police radios and with General Motors for police squad cars, choosing instead to purchase from nuke-free Chrysler. Currently the city treasurer is assessing the banks that hold $1 million in city funds to see if they're "clean."

City contracting affects everything from office equipment and phone services to computers and light bulbs. It demands shopping around, citizens' review, and lots of paperwork to determine who a municipality can do business with. The larger the city, the bigger the task.

The NFZ movement began 30 years ago in Handa, Japan. Although some 5,000 NFZs have been created in 24 countries since then, not a single warhead has been dismantled, not a single defense contract has been canceled. Until very recently the 147 nuclear free zones established in the United States—about 20 a year—have had little economic effect on this country's $300-billion-a-year defense industry, 25 percent of which is nuclear.

"Municipalities are beginning to realize the purse can influence even the arms race," says D. L. Hamilton, program director of Nuclear Free America, a Baltimore-based international clearinghouse for the movement. Hamilton may be right. Today some people in corporate boardrooms are listening: The reason NFZ initiatives have failed in every community where they've threatened existing nuclear weapons contractors is that the companies affected have taken the nuclear free zone measures seriously.

Draper Laboratories, a nuclear weapons guidance-system manufacturer and the prime target of a 1983 nuclear free Cambridge, Massachusetts, initiative, claimed the ordinance would knock out jobs, basic research, and tax revenues. Draper chipped in nearly a third of the $800,000 it took to defeat the ordinance, making the opposition campaign—at $46 per vote—one of electoral history's most expensive. Still, the ordinance lost by only a 60–40 margin.

In a campaign fund-raising letter circulated to defense contractors around the country, Charles Adams, finance-committee chairman of Raytheon, which also opposed the Cambridge initiative, wrote: "Let's make this campaign the last one of its type that we have to battle, rather than the first of many." Cambridge, however, wasn't the last. Expensive and well-publicized defeats followed in Ann Arbor, Michigan, and in Palo Alto and Sonoma County, California.

But the nuclear free initiative was not lost in Marin County, California, last year. The county cleansed its public-funds portfolio of $20 million in nuclear weapons investments in Ford, General Motors, General Electric, and Westinghouse—the largest divestment to date. And the county isn't hurting—it earned slightly higher yields after the "cleansing."

To Ritchie Lowry, a sociologist at Boston College and president of Good Money Publications, an "ethical investments" outfit, Marin County's yields aren't surprising. He contends that nonnuclear companies are a better investment. After a decade of tracking the performance of ten nuclear weapons corporations and ten nonnuclear weapons corporations right through the stock market's crash, he found that the nuclear companies rose 860 percent; the nonnuclear companies rose 1,244 percent. "Defense contractors," Lowry says, "get big bucks in the short term but not the long-term."

Some cities just say no to nuclear weapons.

Marion Anderson agrees. Director of Employment Research Associates, an independent consulting firm in Lansing, Michigan, that analyzes the impact of government policies on the economy, she says, "You generate far more jobs—six thousand more per billion dollars—if money is spent in the civilian economy instead of the military."

The $190 billion military buildup from 1981 to 1985, she claims, cost the nation more than 1.1 million jobs, tied up 30 percent of its scientists and engineers, produced fewer marketable innovations than civilian research would have, and siphoned $39 billion in investment capital out of the civilian economy. More defense money is spent on machinery than on personnel and creates products that can't be used by consumers. The money has left the economy for good. "Military spending is a bad buy for cities and for the economy," she says.

But it isn't bad for national security, defense-spending advocates say. And nuclear free cities, they claim, are a threat to national security. When Chicago went nuclear free, Illinois governor James Thompson called it "stupid and un-American." But local officials disagree, pointing to the growing municipal involvement in shaping foreign policy—everything from NFZs to antiapartheid legislation and overseas trade offices.

Admittedly, the NFZ movement's economic effect is minimal. But the numbers of "free" zones are slowly adding up. If declaring cities nuclear free doesn't reduce the risk of nuclear war, the widening public debate may.

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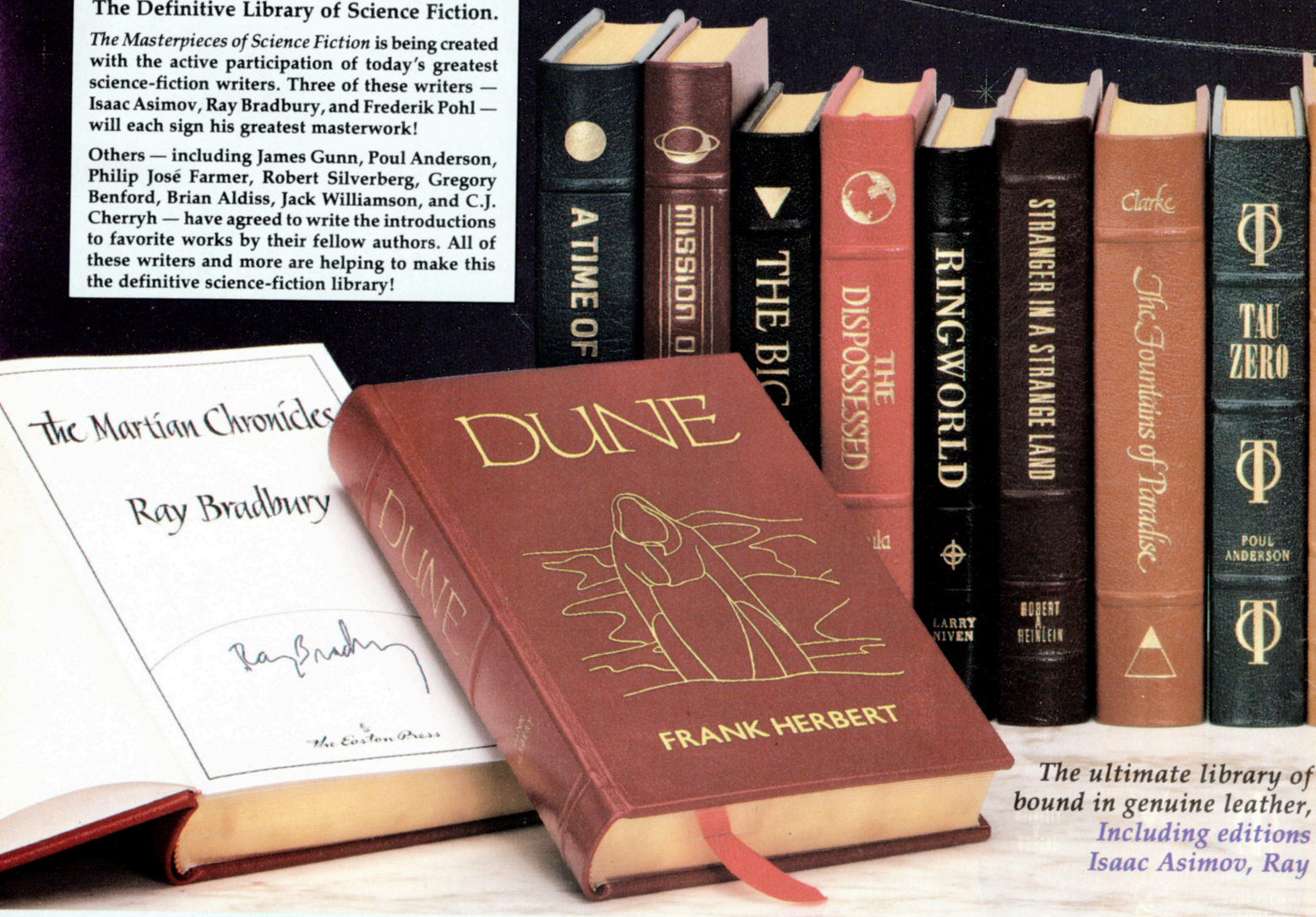

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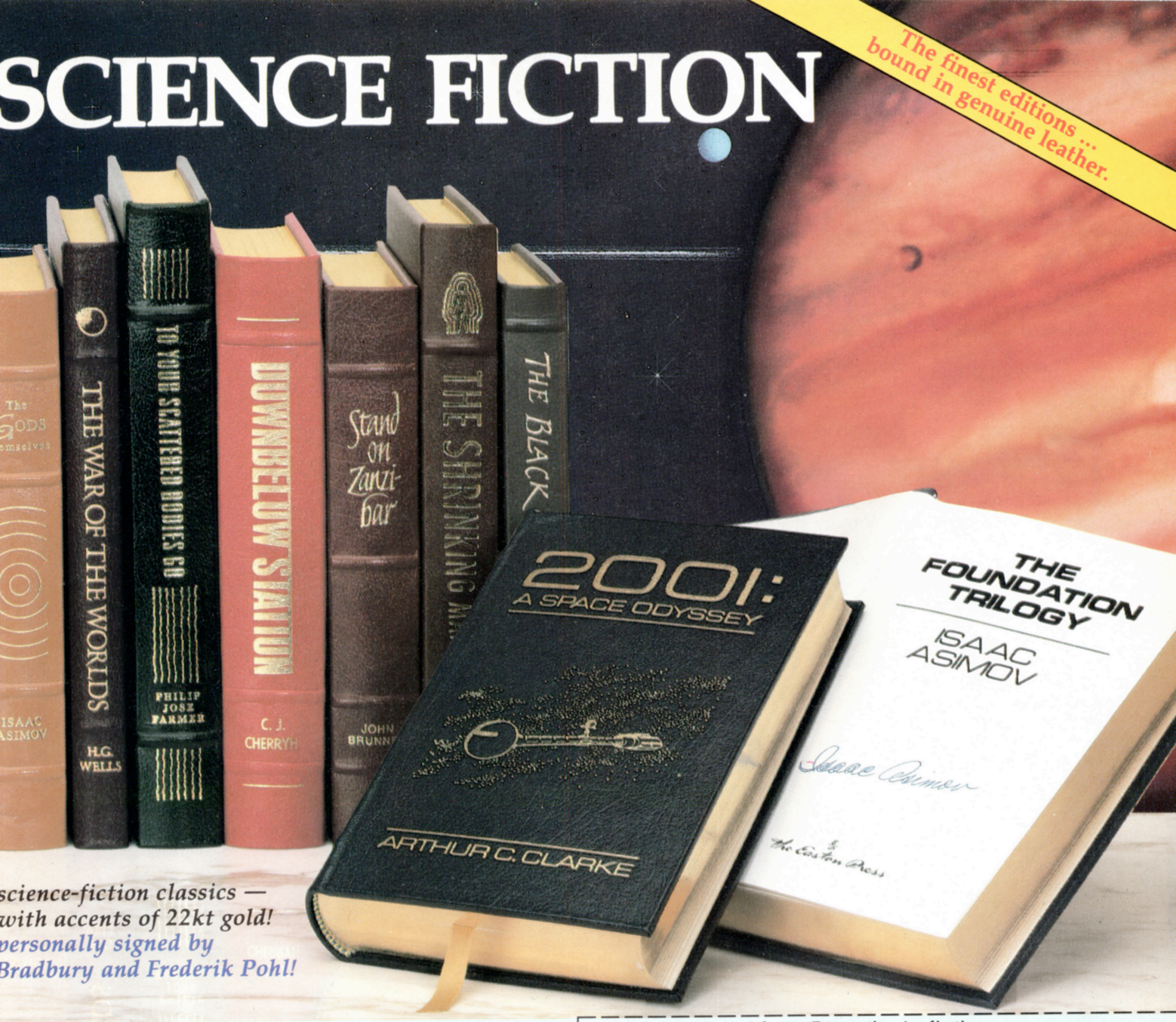

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DIRTY POLITICS

EARTH

By Cathy Spencer

It's a good thing that come November we won't be voting for a President on the basis of his overwhelming concern for the environment. We polled a number of the nation's foremost environmental groups, and none seemed certain that any of the front-runners would be up to tackling the serious ecological issues facing us today. Instead, activists have taken to contemplating an environmental dream candidate.

Here's what he or she would do: immediately implement a comprehensive clean air act that would control acid rain, diminish toxic pollutants, and protect the ozone layer; pass federal legislation mandating recycling programs and waste reduction to solve the nation's emerging solid waste crisis; guard our groundwater from toxic wastes; bolster the Environmental Protection Agency's budget and fill it with environmental experts—not political appointees; and preserve our coastlines, national wetlands, agricultural areas, and national parks. That's what the ideal imaginary candidate would do. What have the real contenders, who may or may not be around by the time you read this, said or done?

Vice President *George Bush* has been dubbed "an environmental disaster" by activists, in part because he has vowed to support the policies of Ronald Reagan. For the past eight years Reagan has opposed all legislation to control acid rain, vetoed the Clean Water Act, and approved the liquidation of the last remaining old-growth forests in the Northwest. Brock Evans, spokesman for the League of Conservation Voters, says, "If we hadn't had a Reagan administration, we wouldn't have had landscapes gutted because strip-mining laws were not enforced. We'd be well on our way to controlling acid rain, and there wouldn't be a push to open up the Arctic Wildlife Refuge for oil drilling."

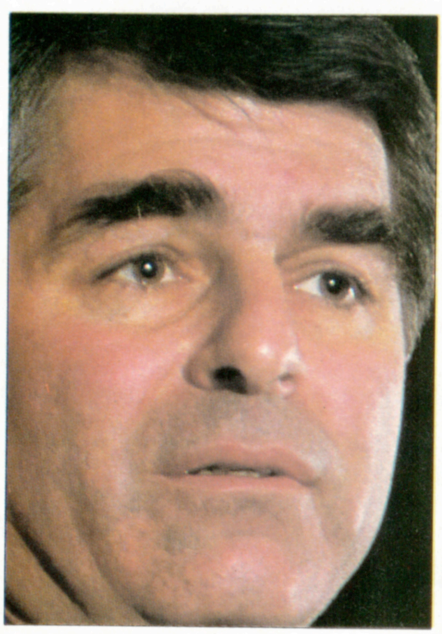
Maybe Bush wouldn't wreak quite as much environmental havoc as Reagan has, though. Bush has diverged (at least in theory) from Reagan's opposition to preserving our parklands. In a speech on June 7, 1987, in Jackson Hole, Wyoming, the Vice President stated, "More can and should be done to ensure that quality outdoor opportunities continue to exist for our next generation of Americans." What Bush considers a "quality outdoor opportunity" is not all that clear, however.

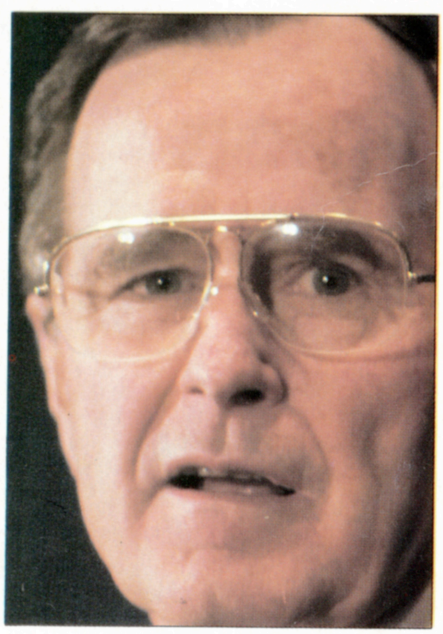
Senator *Robert Dole,* says Daniel Becker of Environmental Action, "has a terrible record on environment issues. He has been a leader in fighting against any type of environmental legislation." Dole was one of only 13 senators who voted against Superfund, the program to clean up chemical-waste sites. He opposed the Clean Air Standards Attainment Act of 1987, which would have required reductions of sulfur dioxide emissions by 12 million tons and of nitrogen oxide by 4 million tons by the year 2000. Dole's campaign aides tell us that even though America must curb acid rain, their candidate doesn't support any of the bills that would help control the problem.

Former TV evangelist *Pat Robertson* has never had to vote or take a stand on problems of the environment. Apparently there's little room in his platform for environmental issues; he hasn't made any statements concerning the environment. When the League of Conservation Voters submitted a list of questions to him, he refused to respond.

On the brighter side, Governor *Michael Dukakis* says, "If there is one thing the next President might do, it is to help build a bright and vibrant economic future for this country. But you can't build that economic future without a healthy environment. The two go hand in hand."

Dukakis supports research and development of photovoltaics, a safe and natural process that converts sunlight directly into electricity. In conservation circles, Dukakis is best known for his fight against the Nuclear Regulatory Commission's (NRC) evacuation plan for the Seabrook nuclear power plant, located in New Hampshire, near the Massachusetts border. The governor, in cooperation with the Massachusetts Civil Defense Agency, decided that the topography, meteorology, and demographics of the six Massachusetts communities within the Seabrook "emergency zone" made a safe





Dukakis and Bush: Who will stop the reign of pollutants, pesticides, and toxic wastes?

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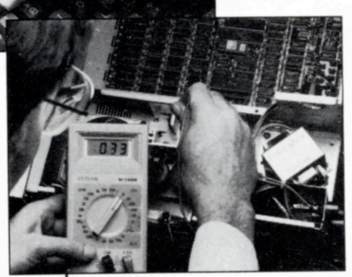

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ARTIFICIAL INTELLIGENCE

By Robert Neumann

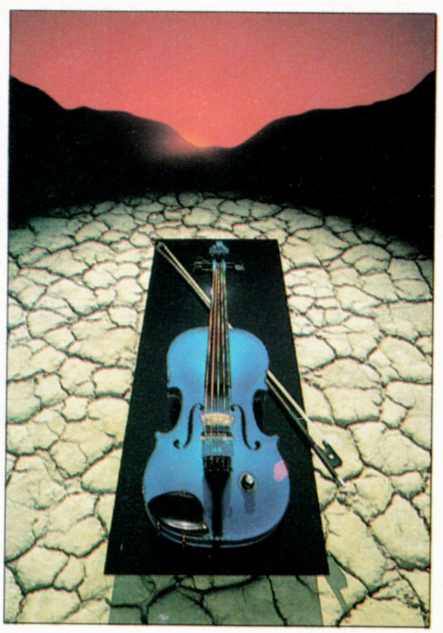
At age thirty-four, music programmer John Mahoney has decided to become a part-time private investigator, a "music fingerprinter" who can electronically determine whether one musician has reproduced sounds from another musician's copyrighted recording. Mahoney's business isn't booming—yet—but he may testify in two copyright infringement suits pending in New York, and other cases are undoubtedly on the way.

In his windowless basement studio jammed with state-of-the-art recording equipment that he uses for his own musical compositions, Mahoney demonstrates how digital sampling makes stealing sounds possible. Digital sampling is done using an electronic device called a sampler, which converts sounds into digital recordings that are stored on computer disks. "I can capture any sound in the universe with digital sampling," says Mahoney. "Once I've sampled [digitally recorded] a sound, I can play it, alter it, do whatever I want to it." Indeed, such digital doctoring has given modern musicians the ability to insert almost any sound—even James Brown's voice—into one of their own pieces.

Mahoney shoves a floppy disk containing previously sampled sounds into a disk drive and, using the Rolls-Royce of samplers—the Synclavier—he selects timpani from a timbre directory on the monitor. When he strikes a key on the Synclavier's piano keyboard, the sound of a deep-bellied drum resounds from massive wall speakers. He can do the same for any note from any instrument. In fact, he can vary the pitch of each note and stretch or shorten the sounds. Mahoney leans back in his chair and clasps his hands behind his head. "I can incorporate any isolated sound into my palette and mix those sounds to make my own creation," he says.

The reproduction of isolated sounds is widely accepted in the music business. Music programmers build large libraries of individual sounds, everything from a note played on an unusual African folk instrument to one that flies off Phil Collins's snare drum. "Part of what you're hired for are your sounds," says Mahoney, who was one of the first musicians to enter the field of music programming when the Synclavier first became popular in 1985. In building a library, programmers may buy sounds from the musicians who created them or sample sounds from compact disks. But that's where Mahoney draws the line. "You could use this technology to cop a melody or rhythm," he explains, "maybe cut up someone else's horn phrase and fly it into your own composition. I don't do that."

Others do copy longer passages, though, and that's where Mahoney's detective work comes in. When he is asked to fingerprint sounds, he must first identify the two passages to be compared. The suspected passage will usually be something that the aggrieved musician thinks sounds "too familiar." That same musician, though, might not remember where the passage occurs in his own composition. Mahoney has to find it and determine if it is a likely candidate for sampling. A sound buried among other instruments or voices is extremely difficult, often impossible, to isolate: It just can't be separated from the other sounds. "But," says Mahoney, "if the sound is laying out in the open and I find it on the other musician's recording, that's a good indication it was lifted."



Are musicians stealing one another's sounds?

Often the samples he examines have other sounds added to them. A horn phrase, for example, might be surrounded by drums. "Then," says Mahoney, "I have to try to filter out what's around the sound. I can get rid of some frequencies, but often they cross over each other, and there's not much you can do."

Once the original and the suspect sounds have been isolated, Mahoney uses the Synclavier to graph the characteristics of each sound. After matching the two starting points and setting the opening pitches to match each other, he programs the Synclavier to graph the relative amounts of each frequency that appear in the sounds. If he finds that the two sounds match, it's a clear case of copying.

It looks likely that Mahoney will take the stand for the first time later this year in one of two infringement suits pending against the Beastie Boys in New York. The rap group is currently being sued for copyright infringement for several songs on their album *Licensed To Ill*. The plaintiffs hope that testimony from a music fingerprinter will bolster that of musicologists, who are traditionally called as expert witnesses in copyright infringement cases. If the court accepts music fingerprinting as viable evidence, the door will be open for more suits. But acceptance of music fingerprinting will also mean that the courts will have to grapple with some new and decidedly sticky problems: The sounds Phil Collins gets out of a snare drum are his, or are they? Can a programmer lift one or two of those sounds without infringing on Collins's copyright? In a profession where legal limits have yet to be set, these cases may determine to what extent the recording industry is licensed to sample.

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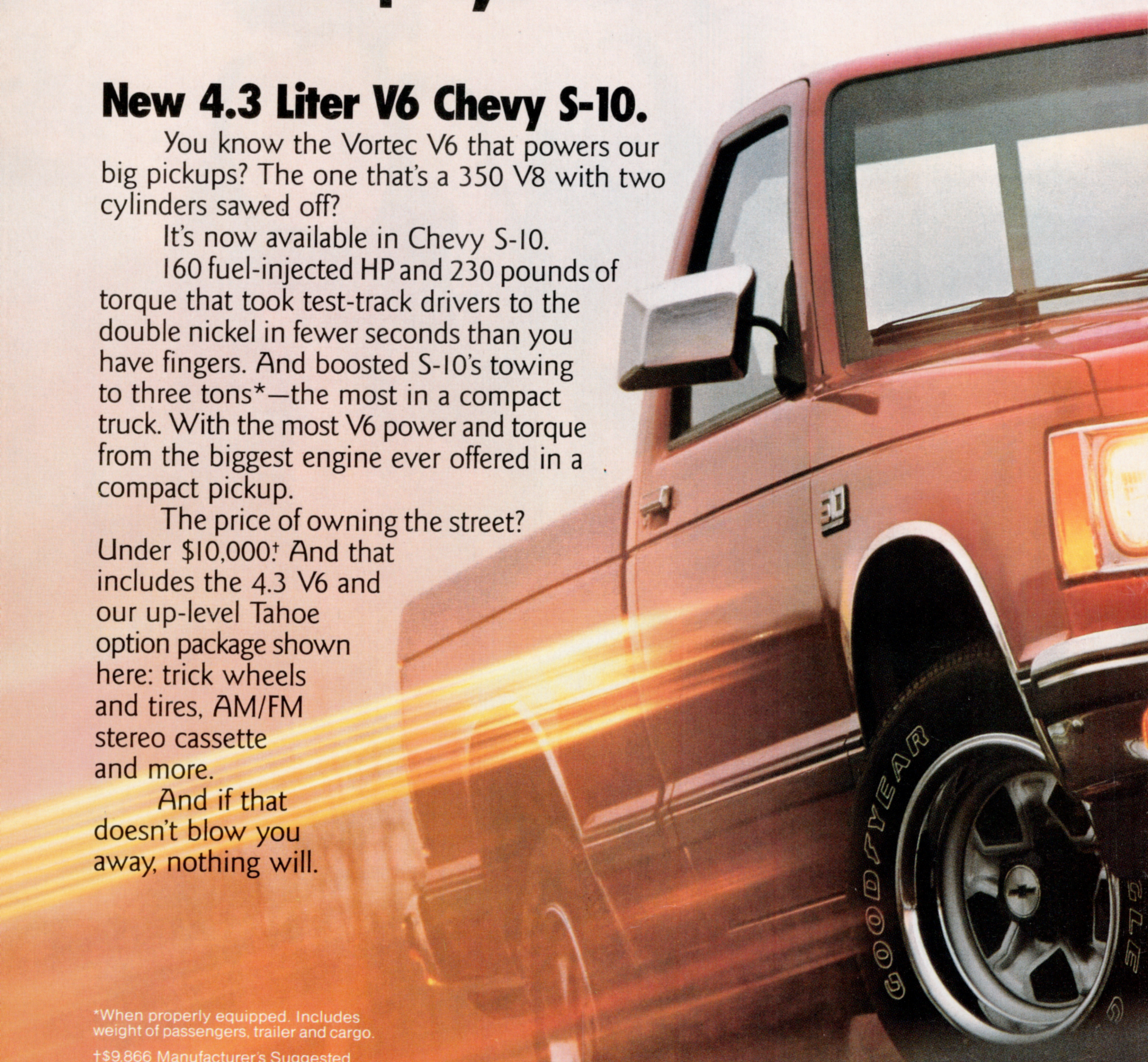

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NURTURING NASA

SPACE

By Lindsy Van Gelder

The minute someone walks into her office at the NASA/Ames Research Center, Dr. Yvonne Clearwater goes into hostess mode, offering mugs of fragrant apple–herb tea and slices of home-baked apple pie. She dunks tea bags and jingles spoons as she ponders the next phase in the all-propulsion, get-the-can-into-the-air-and-make-it-land-where-you-want, "manned" space program of the last quarter century.

She herself has a job that would be the envy of any professional: researching and developing architectural and interior-design guidelines for the permanent U.S. space station that is scheduled to go into orbit in the Nineties. And Clearwater—along with many of her colleagues in the aerospace field—believes that women are now at a point where they can not only compete as equals but also add a unique perspective.

There are more women in space-related careers today than ever before. Still vastly outnumbered by men (with minority women particularly invisible), many can tell horror stories of tokenism and outright discrimination. But the industry that popularized the word *manned* as an adjective denoting a human presence is increasingly "womanned." Sally Ride's historic flight as the first American woman in space is the most obvious example; but the 95-member astronaut corps now has 12 women, including the first black female candidate, Mae Jemison.

The number of female scientists and engineers employed full-time by NASA has risen from less than 3 percent in 1974 to nearly 11 percent today. Although statistics for private industry are harder to come by, NASA also reports a more than 9 percent increase in the dollar amount of NASA contracts awarded last year to women-owned businesses.

During the Sixties and early Seventies, when the women now moving into key positions in aerospace were growing up, there were virtually no female role models. In fact, according to Marcia Smith, a Library of Congress aerospace specialist who recently served as executive director of the National Commission on Space and is a former president of the professional group Women in Aerospace, many of the female science stars of today began as secretaries.

"If you were a woman you had two choices: Type or teach," adds Brenda Forman, a senior policy advisor at a major aerospace manufacturer in Los Angeles.

One of the few women who did come to prominence in the space field before the Eighties was Eilene Galloway, who recently received the first Lifetime Achievement award given by Women in Aerospace. Now eighty-one, she has been dubbed the grande dame of space law.

Galloway had taught political science at Swarthmore College in Pennsylvania and was serving at the time of the first *Sputnik* launch in 1957 as a national-defense analyst for what is now the Library of Congress's Congressional Research Service. Galloway had just finished a report on guided missiles for the Senate Armed Services Committee when she found herself cast in the role of *Sputnik* expert. Within weeks of the launch, then-Senator Lyndon Johnson hired her to help prepare hearings on "The Missile/Satellite Situation." When the Senate soon afterward established the Special Committee on Space and Astronautics, Johnson appointed Galloway as a consultant.

Galloway also helped draft the bill that created NASA in 1958. Johnson next asked her to commence research into the new field of space law, an area she has in the years since become an expert in—from space treaties to the legal ramifications of international cooperation in cleaning up space debris.

But one of her major thrusts these days is the integration of space activities with the humanities. "Today our most urgent and unsolved problems involve those of political science—management [especially from the top level] of space activities, organization in the executive branch, and the role of the government in relation to the private sector," she explains. The bottom line, she says, is that "no matter what your discipline is, it's going to be affected by space."

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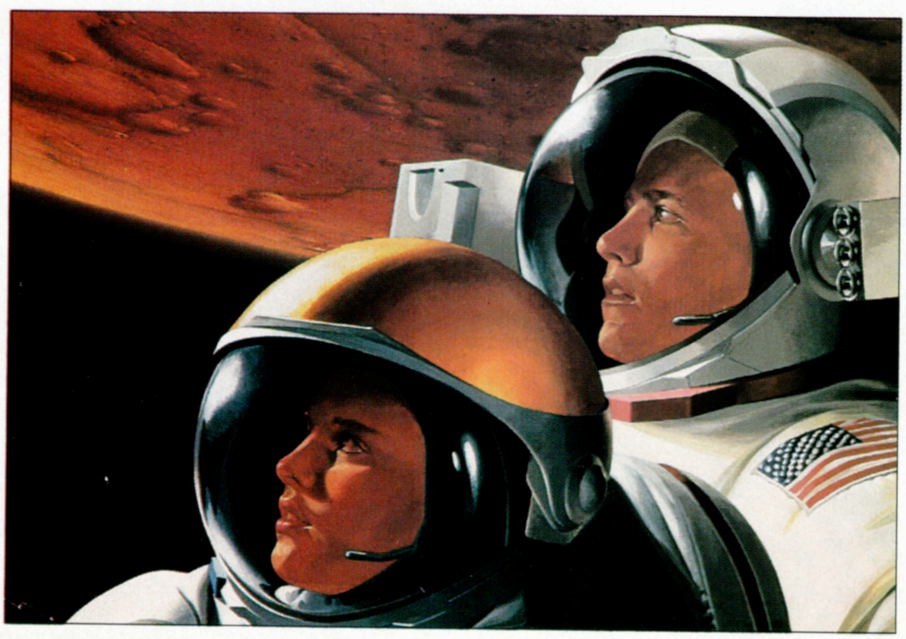

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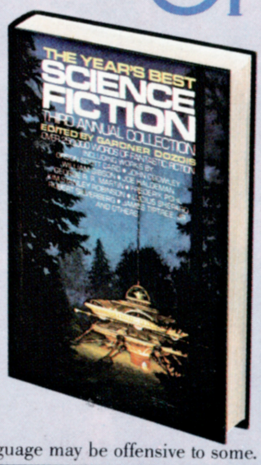

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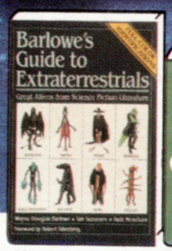

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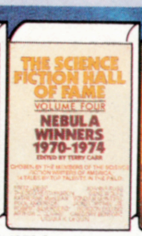

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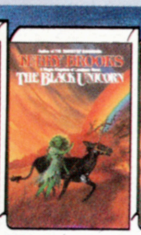

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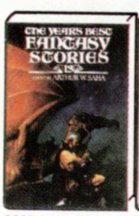

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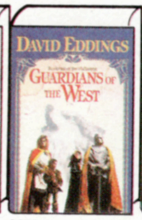

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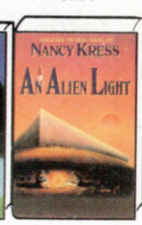

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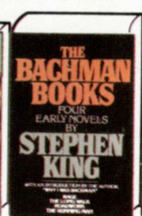

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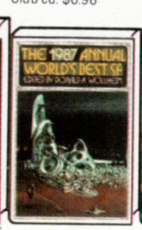

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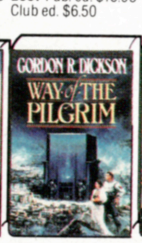

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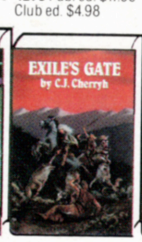

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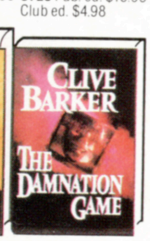

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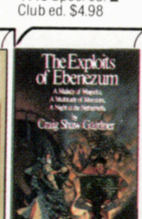

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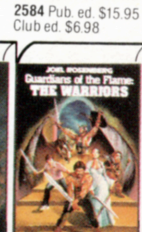

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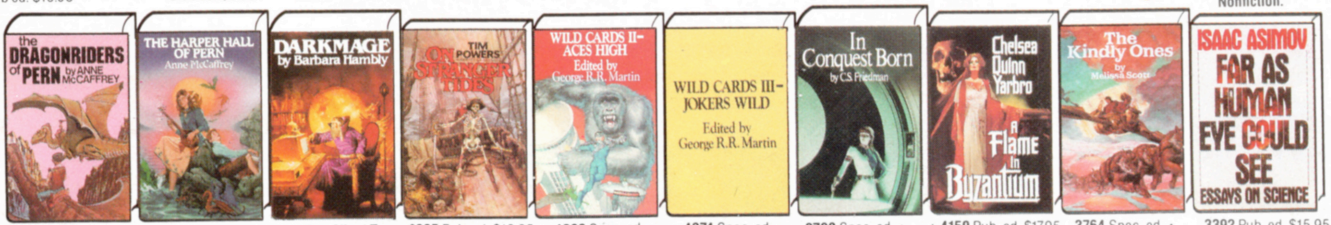

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LONG-DISTANCE OPERATORS

BODY

By Richard Wolkomir

Your hitch as a construction specialist on the ever-growing space station has been uneventful, until now: Your appendix just detonated. The physician on duty in Houston checks you out on the interactive TV and gives you the bad news: Your appendix has to come out—as soon as possible.

The space station has no surgeon, and the next supply shuttle isn't due up for two weeks. Launching an ambulance to bring you down would cost millions. But there's no need to worry—a surgeon on call in Los Angeles is prepared to operate immediately. He instructs medical technicians at your station to ready the robot telesurgeon. (Robots that do telesurgery are equipped with operating arms programmed to mimic the incisions made by surgeons on Earth.)

The medics rush you into the station's tiny operating cubicle and give you a quick CT (computed tomography) scan, beaming the 3-D images of your abdomen to a computer on Earth, which digests the data. The L.A. surgeon reviews your scan, confirms the Houston doctor's diagnosis, and tells the medics he's ready to go ahead with a classic appendectomy. It's time to give you ether, he says, and they slip a mask over your mouth. The last thing you see is the robot's operating arm, a scalpel glittering in its gripper as it starts to rise.

When you awake, you have neat stitches just below your right hipbone. A few days' rest, and you're back on the job.

"I'm not ready to volunteer for an operation like that, and I doubt that you would be," says Scott Fisher, principal investigator for a project called Virtual Environmental Work Station (VIEWS) at the NASA/Ames Research Center in Moffett Field, California. Such telesurgery, an anticipated benefit of the research Fisher shepherds, is decades in the future, he says. But the project is only one facet of VIEWS. Fisher and his team of ten core researchers, backed by squads of outside contractors, are developing a technology of "virtual environments" that could dramatically change the way surgeons are trained in their craft.

The VIEWS project is modeled in part on computerized flight simulators, which offer pilots and aerospace engineers a vicarious version of a given flight experience for training and research purposes. In much the same way, virtual environments will offer surgeons and their students the option to perform an operation on a computerized model of a real or a hypothetical patient before ever cutting into flesh. But while flight simulators provide only graphic data, VIEWS users will receive lifelike images and vivid sensory stimuli. The technology should have an impact on everything from drawing up architectural blueprints to designing salvage missions in the event of a nuclear accident.

The equipment for virtual environments is minimal: The operator wears a helmet like a bicyclist's, with an electronic box smaller than a paperback book fitted in front of his eyes. Inside the box are two tiny video screens, one for each eye. Because the screens are so close to the operator's eyes, special optics in the box provide a wraparound, 3-D view that simulates reality. (Returning to the appendicitis scenario, "reality" would be the actual operating field.) The user must also don electronic gloves. A tracking device on the helmet uses low-frequency magnetic fields to monitor the position of the gloves as well as the direction of the operator's gaze. All the data are fed back into the computer generating the virtual environment.

With telesurgery, only the robot needs to scrub.

As astronauts begin moving out into space, medical emergencies will be a problem. Telesurgery provides one possible solution. Consider the appendectomy, for which the patient is anesthetized in the space station. The surgeon wearing the helmet is in Los Angeles. Looking through the viewer, he sees a computer-generated image of the patient's abdomen, built up from the CT scan and other data. He also sees the robot's gripper holding a scalpel over the man's flesh. With his hands in the electronic gloves, the surgeon moves the robot's grippers as if they were his own hands. While the surgeon performs a simulated operation on the computer-generated man he sees through the viewer, the robot on the space station performs the actual operation on the flesh-and-blood patient. "Telesurgery is decades away because the movements must be precise," says Fisher. "But we've begun working on a learning environment for surgeons."

For teaching purposes, a professor—wearing the helmet and the electronic gloves—could perform an operation on a simulated patient while talking his students through the procedure. (The patient can be generated entirely by computer or from videos of real individuals.) Alternatively, the professor could perform an actual operation as video cameras feed his patient's image directly into the computer. In this case, students might not be in the same room—they could even be on different continents. By wearing equipment identical to their instructor's, they could watch the operation through his eyes. With the electronic gloves on their hands, they would feel whatever the instructor's hands felt as he made his incisions, virtual or actual.

CONTINUED ON PAGE 135

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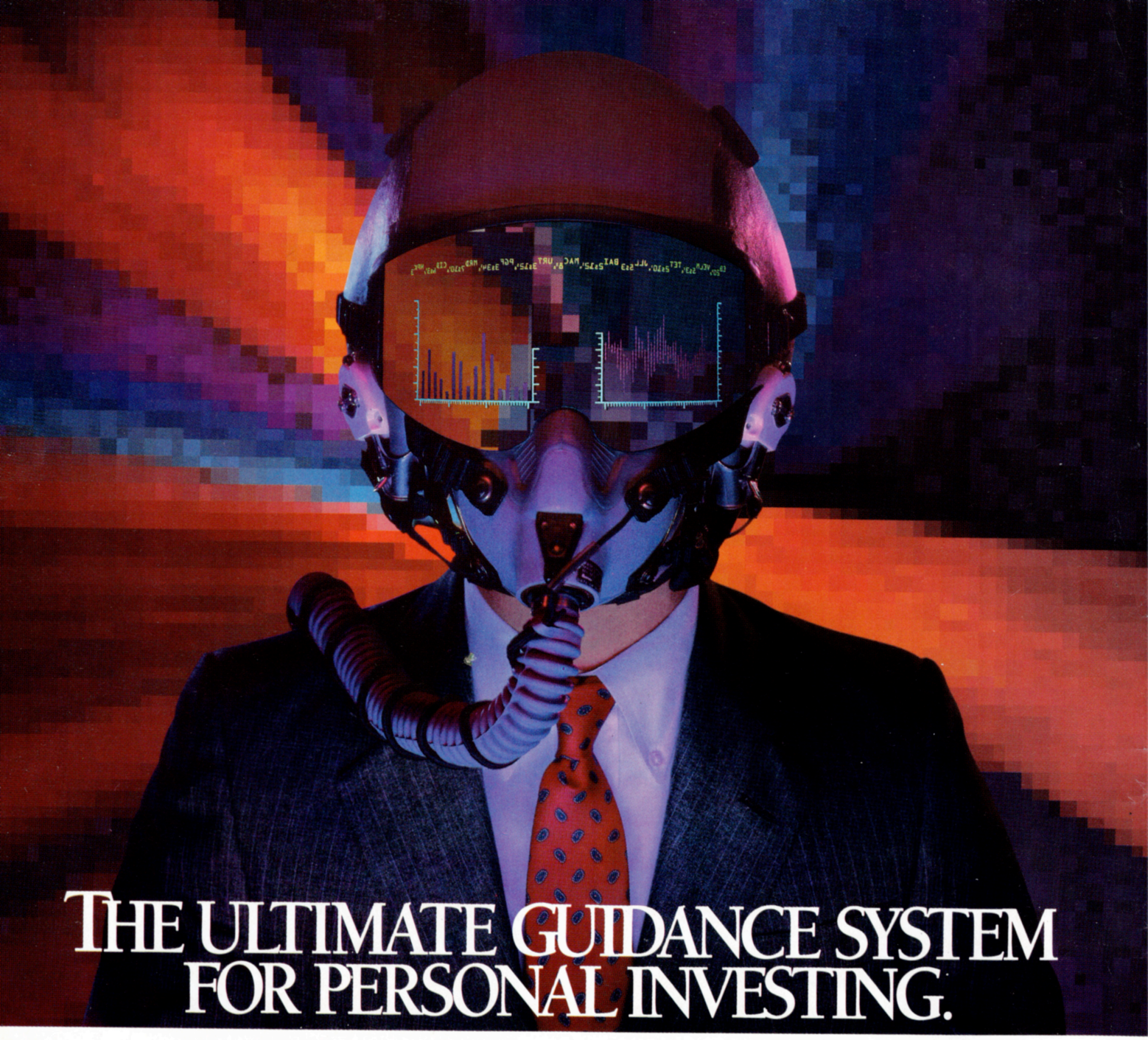

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CONTINUUM

WE'RE SORRY, YOUR TIME IS UP

Emergency room, County Hospital, 2008. Two elderly Medicare patients are wheeled in side by side, both in the midst of heart attacks. The doctors know that an expensive drug called TPA could save both patients. But the law intervenes: One of the patients is seventy-nine, while the other has just passed his eightieth birthday, the legal limit for coverage of heroic lifesaving treatments. The slightly younger patient gets the TPA and lives. With no relatives nearby to assume the considerable cost of the drug, the older patient—his right to coverage for lifesaving treatment having legally expired—is "allowed" by his physicians to die.

This scenario and the wrenching morality play that underlies it are the plausible outgrowths of a controversial set of recommendations advanced recently by one of the country's leading medical ethicists. Daniel Callahan, director of the prestigious Hastings Center in Briarcliff Manor, New York, and author of *Setting Limits: Medical Goals in an Aging Society* (Simon & Schuster), argues that the only way the government can avoid being overwhelmed by accelerating health costs in the next generation is to ration certain kinds of life-extending medical care—bypass surgery, for instance, or organ transplantation, or extended intensive hospital care—to the elderly. And the only equitable standard for that rationing, Callahan insists. is age.

Callahan looks at the numbers—28 percent of today's federal health budget expended on medical care for the elderly, Medicare costs rising 8 percent a year, a continually rising life expectancy—and sees an impending crisis. To head off that crisis and to ensure that the young are not deprived of adequate care in favor of the old, he advocates a top-to-bottom rethinking of our attitudes toward aging, death, and society's moral, legal, and ethical obligations toward its eldest citizens.

The key to Callahan's own thinking and the rationing system he proposes is what he calls the "natural life span." Here he means not biological life expectancy but a "biographical" concept in which society's obligations to an elderly person decrease once that person has "accomplished the ordinary scope of possibilities that life affords": living to see one's grandchildren and realizing some of one's personal and professional goals. Beyond that, Callahan maintains, "society has no obligation to support one's desires to be immortal or even to be one hundred ten."

But how does society pinpoint the age at which one has lived out one's "natural life span" when *natural* means something short of death? Callahan leaves that to future debate, suggesting only that the cutoff point be sometime between the late seventies and early eighties. To those who object that any age standard would be radically unfair in that it would not take individual differences into account—would we deny bypass surgery to a Picasso or kidney dialysis to an Oliver Wendell Holmes?—Callahan has an answer: "In most states people can't drink until they're twenty-one even though there are some fifteen-year-olds who are mature enough to drink and some thirty-year-olds who aren't. And Medicare itself starts at sixty-five. If you're younger than that, you're simply not eligible. There are many established precedents," he concludes, "for using age as a legal standard."

Callahan concedes that his ideas have found few supporters. "Right now," he says, "people think this is outrageous. If there's any consensus, it's that the idea that we could ever use age as a standard [for rationing] in the near future is basically unthinkable." One who finds it quite thinkable, though, is former Colorado governor Richard Lamm, who created a furor in 1984 when he said that "we all have a duty to die" when we grow old. Life-extending care for the elderly, he says now, is a "fiscal black hole into which we can pour this country's entire future. Our octogenarians have the highest life expectancy in the world, and yet we're twentieth in infant mortality. Is this the kind of [medical] policy we want, one that gives the elderly a few more days of pain-racked life yet denies health care to kids?" Lamm is, however, decidedly in the minority.

Perhaps more typical is the response of Dr. Robert Butler, a prominent gerontologist and professor at Mount Sinai Medical School in New York. In Butler's view, Callahan's book is "frightening and disturbing," its perspective "shallow and philosophically dangerous. It ignores eternal verities like decency to elders and is punitive to those people who can least afford medical care. We're not in a calamity," Butler concludes. "We're still the richest country in the world, and we can well afford to take care of our old people."—*BILL LAWREN*

Bill Lawren is a contributing editor of Omni *and author of the recently published book* The General and the Bomb *(Dodd, Mead).*

CONTINUUM

CHERNOBYL ON ICE

The nuclear reactor disaster at Chernobyl announced itself to the world by raising ambient radiation levels as far away as Sweden and Spain. Now comes news that the reactor explosion also left its radioactive signature in the unlikeliest of places: the perpetually frozen snowpack of Arctic Greenland.

Environmental scientist Cliff I. Davidson of Carnegie-Mellon University in Pittsburgh led a group of scientists who were searching the snowpack for evidence of industrial pollutants. Analysis of their samples showed unmistakable traces of two radioactive isotopes of cesium plus strontium 90 at levels of four to eight inches below the snow surface.

The levels of these isotopes in the Greenland snow indicate that the cesium was of very recent origin, and since no aboveground nuclear weapons tests have been conducted since 1980, this constitutes what University of Chicago geochemist Mark Monaghan calls some "circumstantial but strong" evidence that the source of the radiation was indeed Chernobyl.

Though the finding has told the scientists little new about the disaster itself, it should tell them a great deal about how contaminants in the atmosphere are incorporated in the snow. "There's a relationship between what's in the snow and what's in the air," says Davidson. "The radioactive particles from the Chernobyl accident are about the same size as pollutants like sulfates from industrial processes and lead from car exhausts." By studying these particles, scientists hope to learn more about how the atmosphere acts to transport pollutants around the globe.

—Bill Lawren

Chernobyl control room: The disaster's impact is far-flung.

"Living is more a question of what one spends rather than what one makes."

—Marcel Duchamp

"The only difference between myself and a madman is that I am not mad."

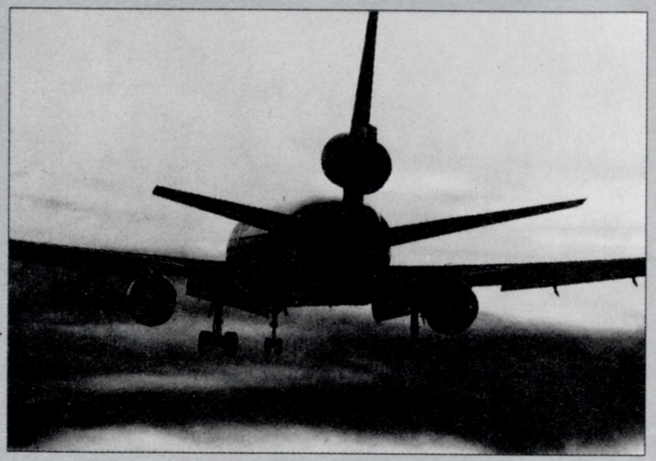
—Salvador Dalí

"Today's robots are very primitive, capable of understanding only a few simple instructions such as 'go left,' 'go right,' and 'build car.'"

—John Sladek

"Pedestrians never seem to realize that they are a threat to the safety of cars."

—Thomas Sowell



Scared of flying? Ever wish you had a parachute onboard? Now a Pennsylvania inventor has come up with a chute for the whole cabin.

EJECTABLE CABIN

Fighter planes have long been fitted with seats that can eject a pilot to safety if the plane is facing an unavoidable crash. Now Pennsylvania pilot/inventor Peter Diamond has patented a similar idea for commercial airliners: an entire passenger cabin that could be ejected from a troubled aircraft and float harmlessly to Earth under a cluster of parachutes.

The cabin, explains Diamond, would sit on diagonal rails attached to the inside of a plane's fuselage. If the plane were headed for a certain crash, the pilot and crew would retire to the passenger cabin and hit the eject button. A set of pneumatic arms would thrust the cabin up and away from the rest of the plane (the force of the thrust would keep passengers in their seats), and the parachutes would open. A set of air bags underneath the cabin would inflate automatically to cushion the landing.

Diamond cautions that the idea would work best at altitudes above 3,000 feet, where the parachutes would have time to open. But even for takeoff and landing crashes, the ejected cabin would at least land on the runway, where, he says hopefully, "I don't think it would disintegrate."

Diamond, who has been flying for 55 years (the seventy-one-year-old got his pilot's license at the age of sixteen), claims the idea came to him decades ago when he was still piloting biplanes, but he patented the concept only recently. Existing airliners, he says, could be retrofitted with the ejectable cabin for about $2 million: "Just cut the top of the plane out, pull out the inside, and slide the ejectable compartment right in." At this writing, Diamond has approached only Boeing with his invention and has yet to receive a response.

—Bill Lawren

ANATOMY OF A YAWN

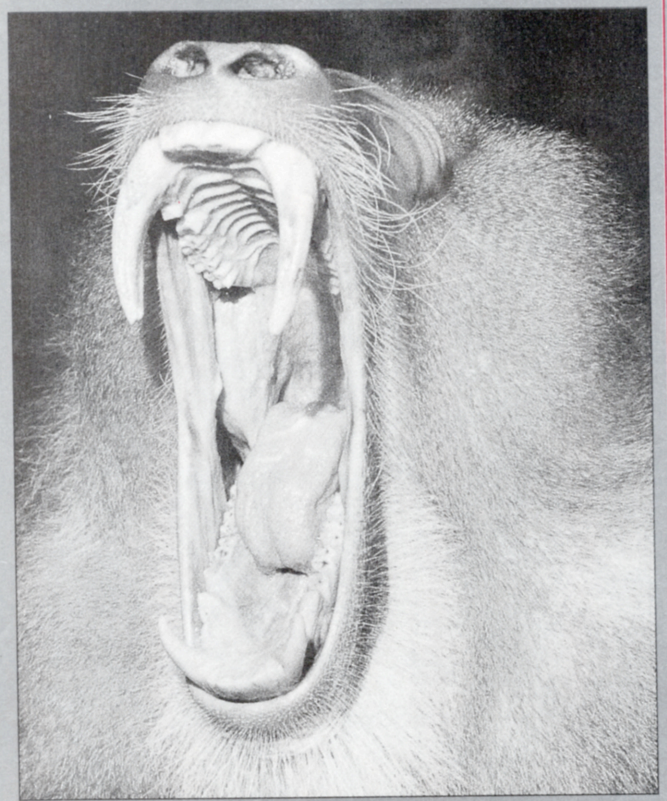
Ever since 1873, when Charles Darwin noted that baboons yawned more frequently in circumstances involving either passion or a threat, the biochemical and neurological implications of the yawn have fascinated researchers like Ronald Baenninger of Temple University in Philadelphia.

After studying lions, mandrills, Siamese fighting fish, and humans, Baenninger concludes that people yawn for different reasons from other animals. "Right now we're long on hypothesis and short on data," he says, reporting that his fighting fish yawned six times an hour before combat and never when they were alone; zoo lions yawned in anticipation of dinner; and the mandrills, usually when seated and hungry but never immediately before bedtime.

Humans often yawn when they are alone or bored and always in situations where they feel safe. "If they think something bad is about to happen, people won't yawn," says Baenninger, puzzled by the difficulty he had getting his subjects to yawn in the lab.

"Yawning may just be a mechanism to keep us awake," says the Temple professor, who edits a journal called *Aggressive Behavior.* In an effort to solve the biological mystery of the yawn, he now plans to take electroencephalograms, monitor heart rates, and give polygraph exams to test his theory that yawning increases the human arousal level. The invariably contagious nature of the yawn also intrigues him.

—George Nobbe



A yawn doesn't always mean boredom. A mandrill (above) never yawns before bedtime. And if a lion yawns at you, you could be his next dinner.

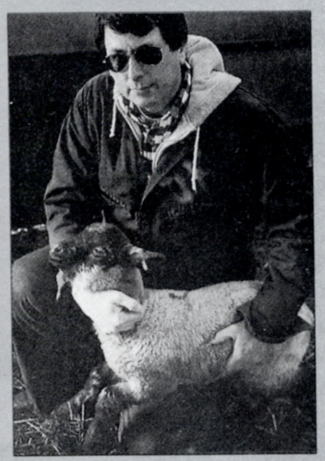
KINKY LAMBS

What stands on all fours, has a penis and a scrotum, urinates like a male, yet is biologically at least half female? It's one of the new experimental lambs produced at the U.S. Department of Agriculture's (USDA) Meat Animal Research Center in Clay Center, Nebraska.

Over the past four years USDA researcher John Klindt has been treating pregnant sheep with precisely timed injections of the male sex hormone testosterone. At birth, the ensuing lambs were all what Klindt calls pseudohermaphrodites: chromosomally female but with a mixed complement of sexual hardware—penises and scrota on the one hand, uteri and ovaries on the other. But what really interested Klindt was that the sexually mixed-up lambs put on weight 10 to 30 percent faster than normal females, yet at the same time they produced meat that was 13 percent leaner.

Klindt can't yet explain exactly how the testosterone injections acted on the fetuses to produce such dramatic changes, but he suspects that they in some way altered the production of important growth hormones. On a more practical level he thinks that these experiments will sooner or later spell good news for supermarket shoppers. "Anything that enhances the efficiency of production gets passed on to the consumer," he says. In this case, Klindt promises, "we'll eventually see cheaper, leaner lamb."

—Bill Lawren



John Klindt holds USDA experimental lamb.

"Any sight is a sum of different glimpses."

—Robert Hughes

"Writing free verse is like playing tennis with the net down."

—Robert Frost

"A national debt, if it is not excessive, will be to us a national blessing."

—Alexander Hamilton

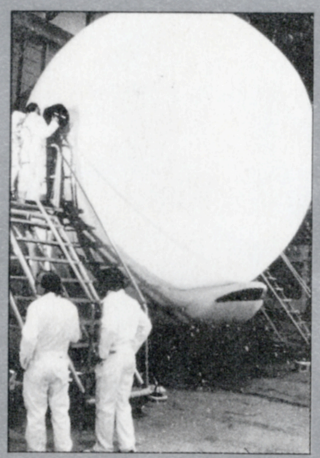
CONTINUUM

A BLIMP FOR STAR WARS

To you and me it's a blimp, but Frederick D. Ferguson, president of Magnus Aerospace Corporation, refers more elegantly to his lighter-than-air (LTA) freight aircraft as a Magnusphere.

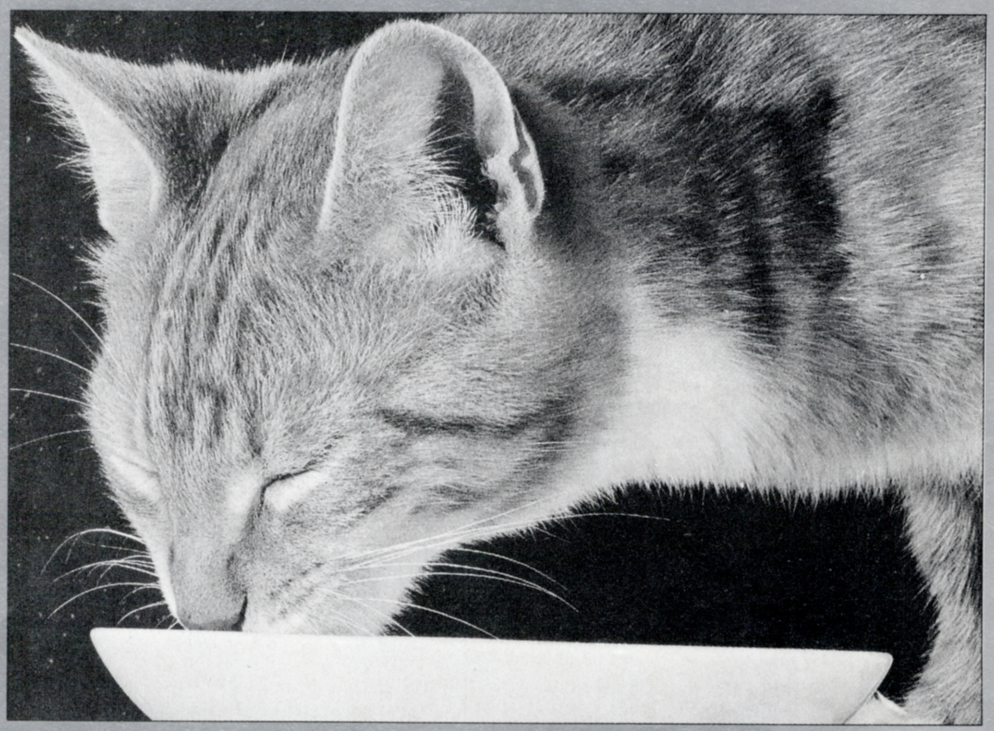
The helium-filled airship—ten years in the making—looks like something out of *Star Trek* and in fact has the contractual backing of the Defense Department as part of the Strategic Defense Initiative (SDI), or star wars. The SDI people are understandably close-mouthed, but a drone Magnusphere can lift three-ton loads to 70,000 feet and maintain its position for a month, making it ideal for hauling aloft such gear as transmitting equipment.

The slightly pressurized Magnusphere flies with the same maneuverability as a helicopter. Spherical in shape, it has a horizontal bar running through the middle of the craft. Twin engines mounted on the bar slowly rotate the sphere, lifting it by the same aerodynamic principle that sends a golf ball flying. The bar also supports a cargo yoke at the base of the strange craft, which takes on air to maintain its buoyancy after cargo has been unloaded.



Magnusphere: Like a big golf ball filled with helium.

Star wars aside, Ferguson says the vehicle's commercial possibilities may be realized before its military uses. At lower altitudes it can lift as much as 400 tons and could haul giant sections of prefabricated buildings, transmission towers, pipelines, offshore oil rig components, even water or fishing catches.—George Nobbe



Cats that don't get enough taurine may risk contracting a degenerative heart disease. Veterinarians recommend giving your cat supplements of this amino acid, which may help humans as well.

CAT NUTRITION

If your cat doesn't get enough of an obscure nutrient called taurine, it's at high risk for a degenerative heart disease called dilated cardiomyopathy, according to scientists at the University of California at Davis.

Give it a regular dose of this amino acid and it will probably be as good as new, according to veterinarian Paul D. Pion, who's studying taurine to find out if it has human applications.

"Taurine is an atypical amino acid," says Pion, who adds, "Nobody is sure what it does." In some animals, the substance aids in the production of digestive bile, helps maintain internal water balance, and ensures healthy eyes. Large concentrations of taurine in the heart may help strengthen a cat's heart muscles, and it has been added to commercial cat food since 1987.

So far, pending ongoing human studies, no one really knows whether the substance could help people or, for that matter, how many individuals have taurine deficiencies. "We're hoping for some answers soon," says the veterinarian.

—George Nobbe

"Whenever I hear the word culture, I reach for my revolver."

—Hermann Göring

HOW MANY ROACHES?

We hate to break this news to you, but deep down inside, you probably suspected it all along. Remember that roach in the kitchen last night? You had a sinking feeling there were more where it came from. You were right. There are a whole lot more. According to a recent study conducted by the University of Florida and the USDA Agricultural Research Service in Gainesville, Florida, for every cockroach you see, there are at least 500 more hiding in your home.

The roach survey was prompted by research into insect growth regulators, synthetic hormones that render cockroaches sterile. "We wanted to know how effective the chemicals were, so we caught roaches in over one thousand apartments and calculated how many of the insects were present," explains Agricultural Research Service entomologist Richard Patterson. "We were surprised at how many we found—an average of thirteen thousand to twenty thousand per home."

Although the apartments surveyed were low-income units in Florida, Patterson emphasizes that the fanciest Manhattan high rise is not immune from huge roach colonies: "If just one apartment has a heavy infestation, the cockroaches spread out between wallboards and in ceilings. They also live in elevator shafts and move up and down until all the apartments are infested."

Even units regularly treated with pesticides are frequently

For every one of these, there are 500 more hiding.

infested with roaches, Patterson points out. That's not surprising, since the cockroach has survived for 350 million years, and many strains are pesticide resistant. "The insect growth regulators will work on cockroaches. But you have to wait six months to a couple of years until the sterile roaches die of old age," says Patterson. "And I can understand someone with thirteen thousand roaches not wanting to wait for that."—Sherry Baker

BODYBUILDER'S PSYCHOSIS

A young bodybuilder decided it would be interesting to ram a car into a tree at 40 mph. While driving down the highway, another weight lifter became enraged when he thought a passing driver had cut him off. So he chased down the motorist and smashed his windshield with a crowbar. According to psychiatrisis David L. Katz and Harrison G. Pope, Jr., of Harvard Medical School, both athletes were suffering from psychiatric symptoms apparently produced by anabolic steroids, a syndrome they have dubbed bodybuilder's psychosis.

Pope and Katz surveyed 45 bodybuilders and football players who all admitted taking steroids to increase muscle mass. They found that about 10 percent experienced psychotic symptoms while using the drugs. "Some had hallucinations or paranoid delusions," Pope relates. "Others had manic symptoms including irritability, hyperactivity, impaired judgment, and uncharacteristically aggressive behavior."

The athletes studied took between 10 and 100 times more steroids than are used in medical studies, which could explain why the medical literature doesn't list many of the known psychiatric effects of steroids.

"Although medical side effects can include liver cancer, they are usually quite mild—like acne and hair loss. But I believe the psychiatric side effects are much more common and serious than the medical ones," Pope notes. "I suspect a lot of incidents of aggression and unusual behavior in athletes witnessed by physicians and police may be attributable to steroids, but no one recognizes it at the time."

Despite the bizarre manifestations of bodybuilder's psychosis, Pope has good news for its sufferers: "The symptoms go away almost immediately in most cases when steroids are discontinued."—Sherry Baker

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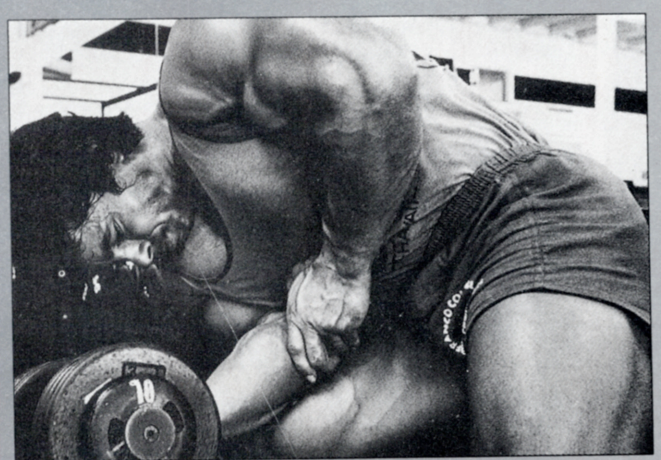
"Looking for temporary Edens is a perpetual lure certainly not confined to writers, who sooner or later discover that the islands of their existence are, in truth, the tops of their desks."

—Alastair Reid

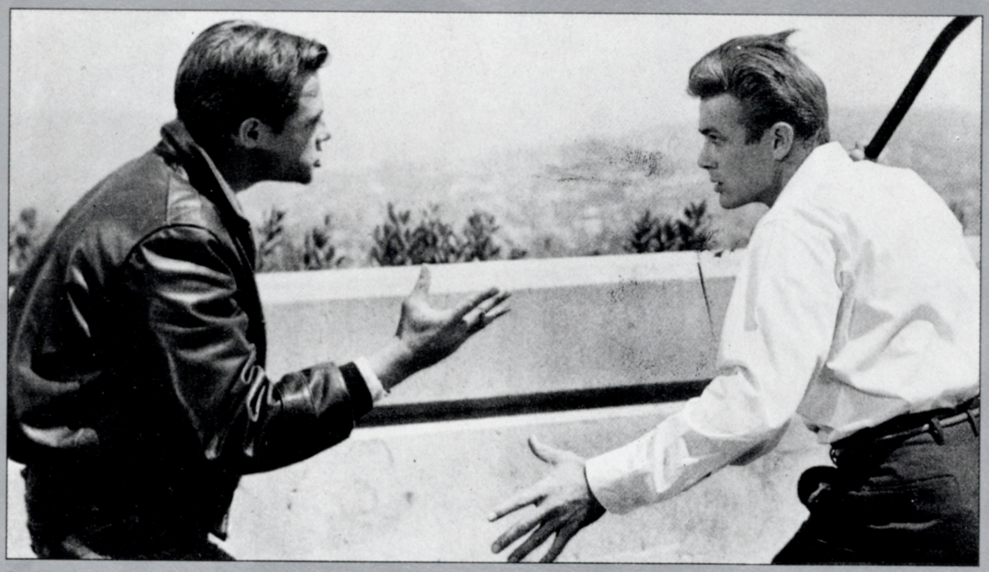
"Eternity is a mere moment, just long enough for a joke."

—Hermann Hesse



Weight training is normally a healthy athletic pursuit, but taking anabolic steroids can lead to dangerous mental problems.

CONTINUUM



Is there a link between sex and risky behavior in teenagers? Yes, according to a San Francisco study, which found that risk taking in adolescents was a precursor to becoming sexually active.

RISKY BUSINESS

Adolescents who begin engaging in risky behavior such as using drugs or driving a car fast may be signaling their intention to become sexually active. In a study of San Francisco eleven- to fifteen-year-olds, University of California at San Francisco psychologist Susan Kegeles and colleagues found this marker was more pronounced among whites than it was in blacks or Asians.

In what Kegeles terms the study's key finding, white adolescents who were thinking of becoming sexually active "are doing more risk behavior than virgins." This couldn't be measured in black males because they tend to become sexually active prior to the ages measured in the study. A risky-behavior–sex link among Asians couldn't be determined because they tend to remain virgins longer than whites, says Kegeles.

To determine the linkage between sexual activity and risky behavior, the students in the study were asked if they had used marijuana, drunk alcohol, ridden in a car when the driver drank or used drugs, driven a car fast, done fancy tricks on a bicycle or skateboard, or taken dares.

Kegeles says these findings are important for parents to understand because eleven- to fifteen-year-olds have several problems that are age specific. The younger adolescent girls are when they start engaging in sex, the more likely they are to get pregnant. Adolescents also have a high rate of sexually transmitted disease and may not be prepared to avoid contracting VD or AIDS, she says.—Joel Schwarz

DEEP-THROAT STRESS

Posttraumatic stress disorder most often plagues survivors of violent events—like Vietnam veterans who are haunted by flashbacks of the war. But a St. Louis woman claims that watching just 16 minutes of the X-rated film *Deep Throat* in 1980 brought on the syndrome, leaving her disabled.

According to court documents, Olivia Young, a medical supply company representative, attended a business conference at the office of St. Louis University Hospital administrator Richard Stensrud. When the meeting ended, Young claims, Stensrud showed the movie.

The shock of that experience allegedly left Young unable to have sex or even do daily chores. In a lawsuit filed against St. Louis University and Stensrud, she demanded $2 million for "grievous emotional shock and mental distress . . . and loss of employment and job opportunities."

Although a psychiatrist testified that Young was indeed suffering from posttraumatic stress disorder, a jury recently rejected her claims for damages.

Emory University psychiatrist Phillip Ninan notes that, as the name suggests, posttraumatic stress disorder most often develops after cataclysmic events. "But it is possible that a more normal type of experience, like seeing an X-rated movie, could result in some milder symptoms related to the disorder," he explains.

Ninan adds that problems associated with posttraumatic stress disorder tend to lessen over time. "Unfortunately," he says, "some people spend their energy on getting retribution with lawsuits rather than getting rid of their symptoms."

—Sherry Baker

Deep Throat: *Can the movie affect daily household chores?*

Animals take it on the lam when a quake is imminent, so one geologist uses the lost-and-found ads as an early-warning guide.

EARTHQUAKES AND CLASSIFIED ADS

Every morning Jim Berkland counts the number of missing cats and dogs listed in the lost-and-found classified sections of three of California's major newspapers. When the numbers go up, it means the state may soon be hit by an earthquake.

For centuries the Chinese have noted that animals can somehow sense when a quake is coming, and part of China's earthquake-warning system is in fact based on observations of animal behavior. Just before a quake strikes, animals become nervous and frightened and often go into hiding. Berkland, chief geologist for California's Santa Clara County, became convinced of the efficacy of the Chinese technique when his own cat ran away from home just before a large earthquake. The cat returned a few months later—just before another quake.

Today he combines the number of animals advertised as missing, data on geyser and tidal activity, and the position of the sun and moon to detect seismic windows—periods when conditions are most favorable for quakes to occur. These windows extend exactly eight days, usually from one day before to six days after a full or new moon. Seismic windows most favorable for earthquakes are marked by maximum high and low tides, animals leaving their normal habitats, and heavy rain. Berkland claims an 82 percent success rate since 1974 in predicting earthquakes that were strong enough to be felt in the city of San Jose and in Santa Clara County.

Theoretically, says Berkland, animals sense the drastic changes in the earth's magnetic field that are precursors to earthquakes, and run away in fear. Not everyone is convinced of Berkland's method, however. Seismologist Leonardo Seeber, of the Lamont Dougherty Geological Observatory in New York, readily concedes that animals respond to quakes. But he adds, "In California you might have a thousand minor quakes a week, and when you have a lot of earthquakes you can find correlations anytime you want to, if you are not sufficiently rigorous."—Joel Schwarz

GLACIAL ICE CUBES

The latest craze at big ceremonial occasions in Japan is "party ice cubes" carved from glacial ice that fell as snow or rain into the fjords of southeastern Alaska thousands of years ago. So popular are the clear bluish cubes that the Japanese will pay as much as $2.50 for a seven-pound bag.

Tim Dimond, a Northland Service Inc. barge company employee, was well aware of the Japanese craving when he first began harvesting the ice, scooping 4,000-pound icebergs out of the waters of Tracy Arm (near Juneau), loading them on refrigerated barges, and shipping them off to Seattle for processing.

Alaskan environmental activists are predictably outraged: "Bringing a barge with a backhoe on it is totally incompatible with pristine wilderness values," says Don Cornelius, a Petersburg environmentalist. Retorts Dimond, who did agree to stop operating in LeConte Bay, "I'm not breaking any laws. There are a few people in the world who feel we're stealing the crown jewels of Alaska."

So while Dimond waits for a permit from the Alaska Department of Natural Resources to harvest ice, he continues to make one side trip a week into the Tracy Arm fjord after his regular Seattle-to-Juneau vegetable run is over, collecting about 100 small icebergs per trip.

The Japanese prize the ice for its clarity and color and the crackling pops it emits as it melts. Dimond says he'll have no trouble selling them at least 200 tons a week.

—George Nobbe

"To avert disaster we have not only to teach men to make things but also produce people who have complete moral control over the things they make."

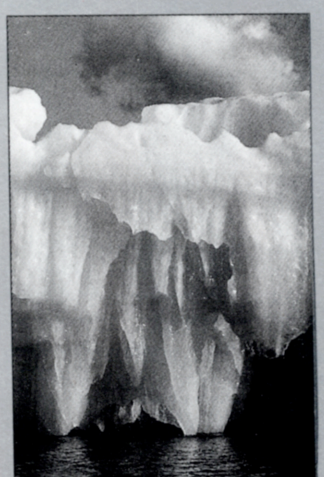
—Prince Charles

"In the fight between you and the world, back the world."

—Frank Zappa

"Myths are public dreams. Dreams are private myths."

—Joseph Campbell



Glacial ice emits a nice pop when it melts in a drink.

CONTINUUM

NEW SPACECRAFT MATERIAL: WOOD!

It took NASA thousands of dollars and hundreds of hours to come up with the right materials for spacecraft heat shields: a plasticlike substance for the Apollo capsules; low-density silica tiles for the shuttle. Now that the Chinese are getting into the business of space, they have developed their own brand of heat shield: a slab of oak.

The Chinese have reportedly launched nine satellites that use the oak heat shields, and they planned to launch another one this spring. The idea isn't as farfetched as it sounds. Back in the early Seventies NASA tested the heat-shielding properties of mahogany, maple, and balsa wood. One of the problems with a wood shield, says Don Curry, a NASA space shuttle subsystem manager, is that the char layer—the carbon layer that forms as the wood burns—is weak. As a result, when the char layer is subjected to pressure, vibration, and the various other stresses of reentry, it's liable to fall off. For the cargo inside the satellite, that's very bad news: Without the char layer, the remaining wood burns faster. And if the wood isn't thick enough, the shield can literally go up in smoke.

That doesn't mean that you *can't* use wood as a heat shield. You just have to use it under the right circumstances, says Curry. In launches where the temperatures during reentry are relatively low, wood works fine. The Air Force has used cork shields in launching some of its ballistic missiles without any problems.

—Devera Pine

"With the exception of man, no being wonders at his own existence."

—Arthur Schopenhauer

"It is a mark of modern ignorance to think that we have become progressively smarter. . . ."

—Thomas Goldstein

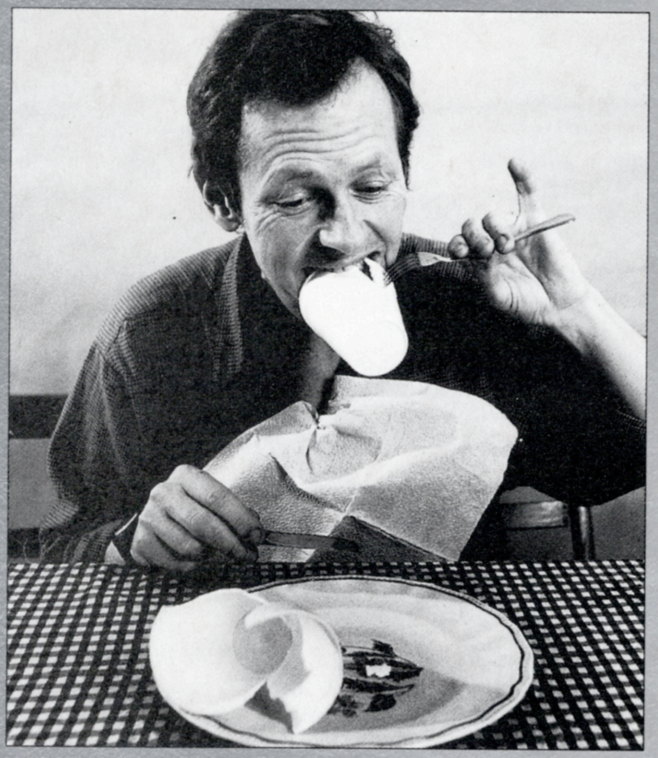
"The follies which a man regrets most in his life are those which he didn't commit when he had the opportunity."

—Helen Rowland

SUPER HAIR BALL

As a medical emergency it was nothing highly unusual: A thirty-five-year-old Kansas City man was admitted to the Truman Medical Center complaining of stomach pains and internal bleeding. But when surgeons went into his stomach to find the source of his problem, they got the surprise of their lives—they found an eight-centimeter-long, egg-shaped bezoar. That's a hair ball, but this one didn't have a hair in it. In fact, it was as hard as glass and made entirely of polystyrene (what most of us call Styrofoam).

The patient admitted to a fondness for nibbling on polystyrene cups, a new psychological malady that the doctors promptly dubbed polystyrenomania. The patient's confession solved the mystery as to how the strange bezoar got there in the first place. But a greater mystery remained: How could a substance as soft and porous as polystyrene turn into the virtual equivalent of a marble, especially in the powerfully acid environment of the human stomach?



Polystyrenomania: Eating polystyrene cups can be hazardous to your health and can also result in a hard-as-glass hair ball.

University of Missouri chemist Eckhard Hellmuth set himself to solving that puzzle. He remembered that the dairy industry never stores milk in polystyrene containers because the milk breaks down their ability to withstand stress. Hellmuth now thinks that butterfats in the patient's stomach broke down the bonds among the polystyrene molecules, and pressure from stomach muscles restructured those bonds to form a glass.

Hellmuth is still testing this notion in the laboratory. In the meantime, he issues a caution to latent polystyrenomaniacs: "Don't eat Styrofoam," he says. "It can be hazardous to your health."

—Bill Lawren

"Realism . . . has no more to do with reality than anything else."

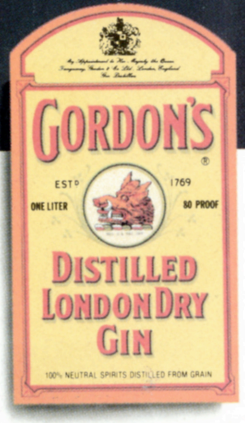
—Hob Broun

"The large brain, like large government, may not be able to do simple things in a simple way."

—Donald O. Hebb

ENGLAND

KNOWN FOR ITS PLAYBOYS.



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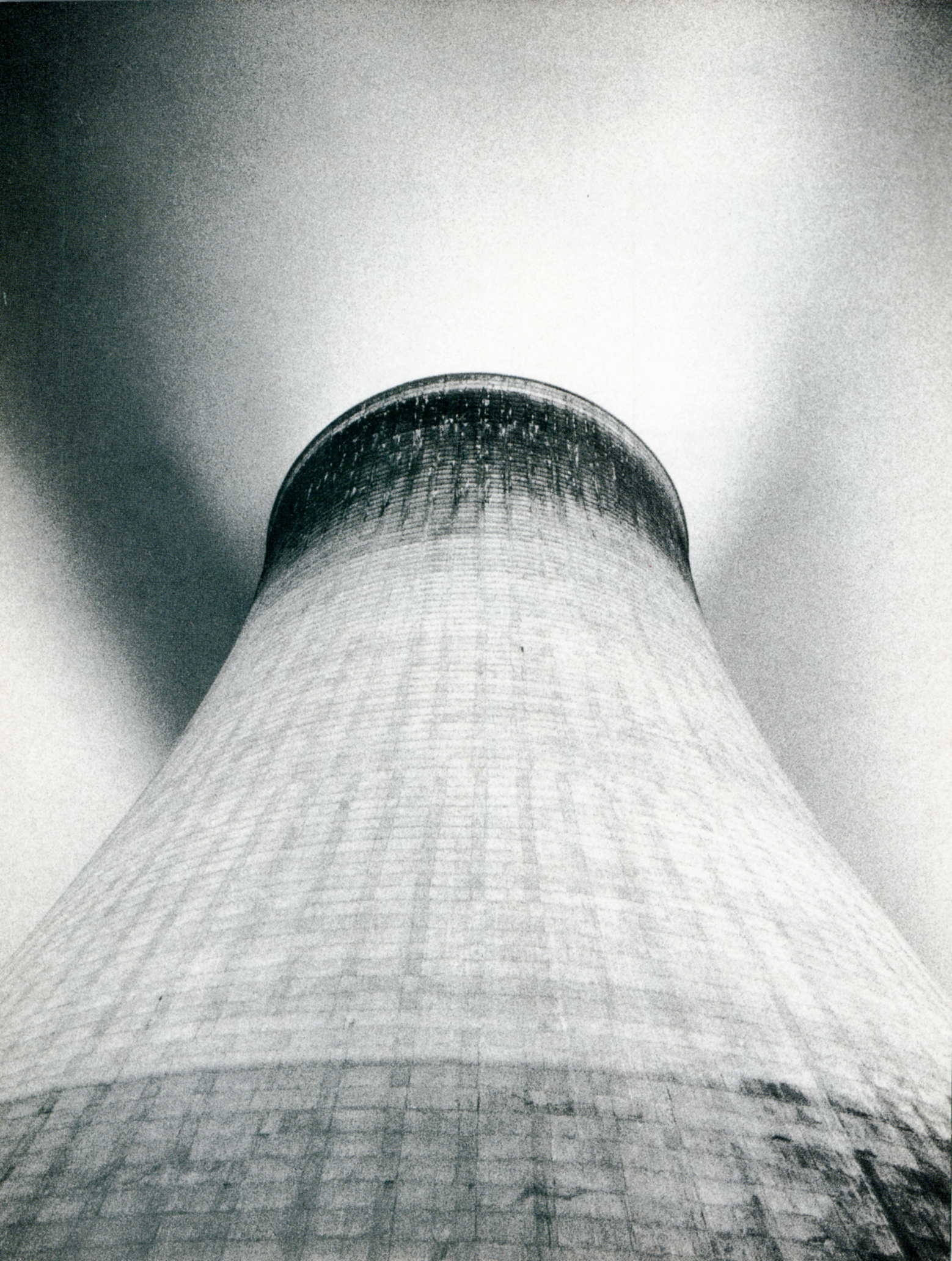
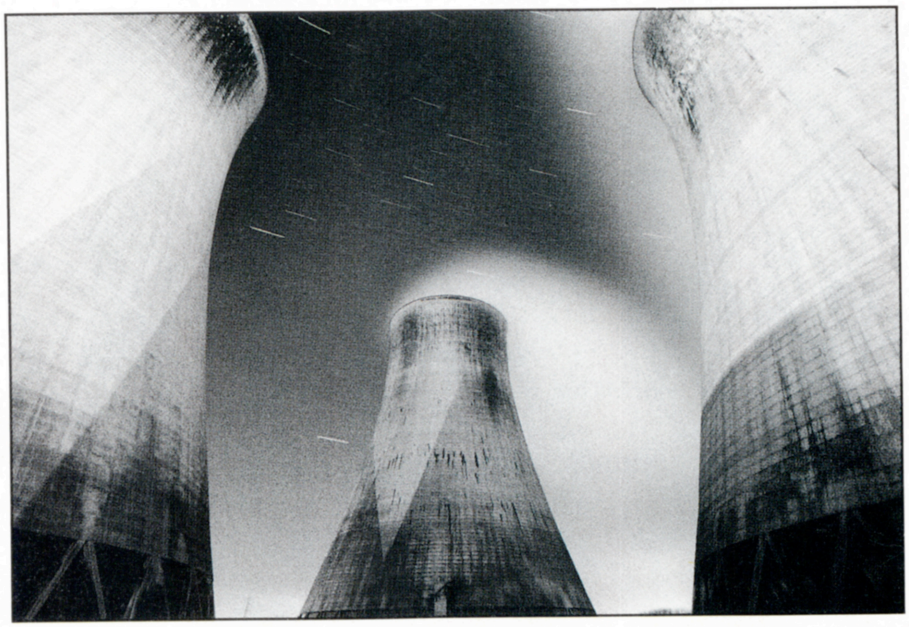


ARTICLE

Solar power's still a dream; oil's an economic nightmare; coal is just plain dirty. There's lots of uranium available, so what's the problem?



NUCLEAR REACTIONS

BY JOEL DAVIS

It is a foggy, cold morning, and I am in the middle of an evergreen forest on the outskirts of the tiny town of Satsop, 40 miles west of Olympia, Washington. The huge parking lot at the Satsop nuclear power plant is empty, no sign of life. Suddenly two hard hats in a red pickup truck zoom past, breaking the silence. The top of the nearby cooling tower is shrouded in mist, but I can see the rust streaks on the containment building of nuclear power plant 3, WPN-3. Steel reinforcing rods poke out of the concrete structure, a grim parody of the coniferous forest surrounding the site.

I drive up to the guard's trailer. A middle-aged man in uniform sits at his desk drinking a cup of coffee. No, he says, I can't just wander around, but I can talk to the public relations person. When I find the P.R. man's hideout, the trailer is locked and empty. A note on the door tells a local teacher that the man has gone to lunch and will be back by one-thirty for the fifth grade's tour. I look at my watch. It is not even eleven A.M.

In the Seventies the Washington Public Power Supply System, or WPPSS (pro-

PHOTOGRAPHS BY MICHAEL KENNA

nounced by some as *whoops*), planned to build two nuclear power plants on this site. When work stopped in 1983 WPN-3 was nearly finished. Its companion, WPN-5, was abandoned a year later—less than a quarter of the construction completed. Today Satsop is a multimillion-dollar wasteland, a symbol, some people say, of the death of nuclear power in this country—a failed technology, a modern-day Icarus. The evidence: No nuclear power plant has been ordered since 1978. In fact, between 1980 and 1984, 53 nuclear power plants at 31 different sites were canceled. The existing 125 reactors—either operating, being tested, or being constructed—are well below the 236 projected by utility companies in 1975. And after the Three Mile Island (TMI) fiasco and the 1986 Chernobyl disaster, the death wishers claim, the lid on nuclear power's coffin is being nailed shut.

Not everyone agrees, however, that the industry is dead, much less dying. In no way is Satsop a symbol of technological failure, states Carl Goldstein, vice president of the U.S. Committee for Energy Awareness (USCEA), a private, nonprofit association of more than 400 organizations with an interest in energy and electricity issues, especially the use of coal and nuclear energy to supply our electrical needs. "Satsop represents a financial debacle: large price overruns, plummeting oil prices, slow growth in demand in the late Seventies, high interest rates, regulatory delays"—and yes, some public concern after TMI. Quietly adamant, emotions restrained, Goldstein recounts these facts: As of last January, 109 nuclear reactors were operating; another 14 units had received construction permits, and two more were on order—all slated to be in operation by 1997, generating enough electricity to service 20 million people. Already, Goldstein notes, 18 percent of electric power in this country is produced by nuclear plants. "That's a lot of electricity, hardly the sign of a dying industry."

NATIONAL ENERGY DIET

Like it or not, American society is becoming "electrified": light bulbs, air conditioners, TV sets, stereos, stoves, refrigerators, water heaters, personal computers, mainframes, toasters, tools, telephones, steel furnaces, drill presses, automated factories, photocopy machines. Where's the generating power coming from? Our sources of electricity are coal (about 55 percent), nuclear power (18 percent), hydropower (about 11 percent), gas (10 percent), and oil (about 5 percent); less than 1 percent is supplied by the stepchildren—geothermal, wood, solar, and wind.

But the wind doesn't always blow, and the sun doesn't always shine; there aren't that many dams that can be built, and anyway, hydropower needs rain and snow; coal has got its drawbacks—environmental pollution and health hazards; oil is problematic—OPEC controls two thirds of it. America's share of global oil production—4 percent—requires us to import, and we imported $41 billion worth of oil in 1987. That's a big dependence on open sea-lanes in the Persian Gulf. That also represents more than one third of the nation's trade deficit. But the United States does control one fourth of all the coal and uranium in the world—"enough," says Goldstein, "to last us for hundreds of years."

Since 1973 overall demand for electricity has increased about 40 percent, and based on North American Electric Reliability Council projections, we'll be using 34 percent more electricity by the year 2000. We're not, to the dismay of the antinuclear people, changing our life-styles fast enough to curb the intense process of electrification. To the believers it's perfectly clear: Go nuclear—electricity is crucial to maintaining our industrial strength, our international competitiveness, and our national security. "But as long as the public believes there is no energy problem, the development of nuclear as well as other energy sources will not move further," says Harold Finger, president of the USCEA. "This country has little existing capacity for future electrical generation outside of old oil-burning plants. When the crunch comes, we'll be forced back to burning oil, as if we never learned the difficult lessons from the oil embargoes of the Seventies."

"As of last January, 109 nuclear reactors were operating; another 14 units had received their construction permits, and two more were on order—all slated to be in operation by 1997."

INTERNATIONALE

Finger and others like him—the engineers and executives of the companies that build nuclear reactors—do acknowledge that there is a hiatus in nuclear power development in this country. But overseas orders for our reactors are increasing—a vote of confidence for the industry in general and for America's standard light-water reactor (LWR), such as the one at Three Mile Island. As with the boiler in a coal-, oil-, or gas-burning power plant, an LWR produces steam to drive a turbine, which turns an electric generator.

Countries like Italy, Spain, and Japan are working in varying degrees with American reactor companies. Great Britain is building an advanced U.S.-style LWR. The Soviets, even before the accident at Chernobyl, chose the American LWR. South Korea is ordering two updated LWRs from an American manufacturer; and ironically, the Japanese, the first ones to experience the destructive power of the atom, will build several advanced LWRs developed here. Then there is the famously successful nuclear program in France, which provides more than 70 percent of the country's electricity—almost entirely from LWRs.

From Belgium to Bulgaria, Argentina to Brazil, Turkey, Thailand, and Taiwan, the world appears to be going nuclear. Five hundred ninety plants in 41 countries outside the United States are in various stages of development: 285 plants are operating; 131 are under construction; 9 are on order; and 165 are in some firm stage of planning. Seventy percent of these reactors are variations on America's standard LWR.

A HOUSE DIVIDED

Very few people in the industry dispute the fact that business on the home front is bleak. What they disagree on is the reactor design of the future—the dream machine that's simple, small, efficient, and, most important, safe enough to convince the American public, once again, to vote nuclear. The inside debate over which model to go with is intense.

John Graham, the Washington, DC, representative for the American Nuclear Society, describes the division in religious terms. "The old-time-religion people—company executives and some engineers—control the nuclear lobby." They believe the United States soon will need more reactors. When that happens, their answer is an advanced version of the light-water reactor. A smaller group of old-timers claims that while the LWR has been proved and is safe, we need smaller reactors with more passive safety features. Example: emergency coolant tanks placed above the reactor core so gravity and not electrical pumps would send the coolant pouring into the core in case of an emergency. No human intervention necessary.

The new-religion people—many of them university professors and laboratory researchers—believe Americans will never accept light-water reactors again. Three Mile Island was a light-water reactor, they point out, and look what happened. Graham's new-religion people include Alvin Weinberg, the former director of the Oak Ridge National Laboratory; research metallurgist and author Ronald Klueh; and Alan Schreisheim, director of the Argonne National Laboratory. They give speeches and write articles with titles such as "A Second Nuclear Era?" and "Nuclear Power: The Second Coming" and "After Chernobyl—A Powerful Vision."

They place their hopes in the newest designs. Called "inherently safe" reactors, these use laws of nature and simple principles of physics to preclude the possibility of a nuclear meltdown. Something brand-new, they say, something inherently safe, needs to be sold to an anxious public

GREAT PRESENTATIONS

THE OMNI SUMMER STYLE GIFT GUIDE

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14K-gold diamond-cut charms, this page: 501 ($85) **$59**; 502 ($50) **$35**; 507 ($76) **$53**; 508 ($54) **$38**; 509 ($40) **$28**; 510 ($63) **$44**; 511 ($171) **$119**; 514 ($81) **$57**; 515 ($76) **$54**; 516 ($49) **$35**; 517 ($72) **$49**; 518 ($67) **$47**; 520 ($72) **$49**; 522 ($193) **$109**; 527 ($193) **$135**; 528 ($121) **$85**; 532* ($276) **$198**; 533 ($166) **$93**; 540 ($180) **$100**; 543 ($144) **$99**; 544 ($90) **$68**; 546 ($50) **$35**; 547 ($103) **$73**; 548 ($81) **$55**; 549 ($40) **$28**; 550 ($100) **$69**; 551 ($166) **$115**; 552 ($72) **$49**; 553 ($81) **$57**; 554 ($67) **$47**; 555 ($85) **$65**; 556 ($45) **$32**.

Women's jewelry, facing page: 604-7 Flat Link 7″ Chain ($158) **$87**; 604-24 Flat Link 24″ Chain ($540) **$297**; 605-7 Bizmark 7″ Bracelet ($95) **$55**; 605-16 Bizmark 16″ Chain ($216) **$121**; 606-7 Puffed Link 7″ Bracelet ($265.50) **$157**; 701 Double Heart Ankle Bracelet w/Freshwater Pearls ($95) **$61**; 702 Rose Ankle Bracelet w/Freshwater Pearls ($86) **$56**; 703 Multicolor Heart w/Freshwater Pearls ($100) **$65**; 801 14K Gold & Diamond Tennis Bracelet, Approx. 1.75 Carats ($2,862) **$1,908**; 802 14K Gold & Diamond Studs, Approx. ⅛ Carat ($185) **$123**; 803 14K Gold & Diamond Studs, Approx. ⅕ Carat ($272) **$182**; 804 14K Gold & Diamond Studs, Approx. ¼ Carat ($344) **$229**; 805 14K Gold & Diamond Bow w/14K Gold Chain ($930) **$599**; 901 14K Gold Hand-Engraved Bangle ($324) **$193**.

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if the nuclear Lazarus is to rise again.

According to the old-timers, some engineers claim too much for their designs. "All reactors use laws of nature and simple principles of physics," says Goldstein. "It is important to understand that *inherently safe* does not mean *perfectly safe.* No nuclear process or nuclear facility is perfectly safe. It is not correct to label some reactors as inherently safe and others as not inherently safe." They all, however, hope that one of these models will provide the industry with its longed-for messiah.

YANKEE DOODLE DANDY

The standard American LWR is based in part on the design of the highly successful reactors that power America's nuclear submarines. The two main versions: pressurized water reactors (PWRs) and boiling-water reactors (BWRs). In any nuclear power plant, no matter what type of reactor it has, heat is produced by the fissioning of uranium atoms. The atomic nucleus contains two kinds of particles: protons, with a positive electrical charge; and neutrons, which are electrically neutral. If the uranium nucleus is bombarded by neutrons, it splits into two smaller nuclei. That process is called fission. A fissioning uranium nucleus releases several neutrons of its own, which cause other nuclei to fission, releasing more neutrons—and so on. The result, called a chain reaction, produces vast amounts of energy.

PWRs and BWRs use the heat generated by nuclear fission to power generators. In a PWR, water under pressure of 2,000 pounds per square inch flows through the core, where it is heated. It then goes to a steam generator and heats a second closed loop of water. A BWR operates in a similar fashion, except that the water in the primary loop is under less pressure. The water turns to steam and is piped directly to the turbines. In both types, control rods are inserted into the core to shut down the fission reaction. In both, the core is bathed in a liquid coolant. If the core should suddenly lose its coolant, operators release water from emergency tanks to flood the reactor and cool it down. Light-water reactor cores are designed so that if the water in the core region begins to turn to steam or is lost, the neutrons scatter. It is then impossible to sustain a nuclear chain reaction, and the reactor shuts down.

Even though LWRs are protected by "active" components—pumps, valves, diesel generators—they are vulnerable to similar problems: electrical failures that prevent emergency generators or emergency cooling pumps from working; human error (pumps get turned on or off when they shouldn't be, and valves can be placed in incorrect positions); and erroneous computer commands. The result: the Three Mile Island near disaster and other serious incidents, such as the cable fire at the Brown's Ferry reactor in Alabama in 1975. Workers were trying to locate the source of an air leak in the cable room next to the reactor—with candles. Fire accidentally broke out, destroying electrical cables connected to the reactor and disabling many of the safety systems. (The reactor at Chernobyl—the only one of its kind—was a hybrid, a graphite moderator design that used light water.)

NEW AMERICAN STANDARD

Light-water reactor engineers believe future LWRs should have more passive safety systems—using natural physical laws such as gravity—to keep accidents from occurring. Karl Stahlkopf is an old-timer. He directs the advanced light-water reactor (ALWR) programs for the Electric Power Research Institute (EPRI), based in Palo Alto, California. EPRI, a research-and-development organization, is supported by utility companies. They dictate the types of reactor designs to develop and the design requirements—simplicity, safety, and an improved man–machine interface are the watchwords at EPRI. While EPRI is working on three fundamentally different reactor designs, Stahlkopf says his organization has placed top priority on a national program to create passively safe ALWRs for the Nineties and the twenty-first century.

"I never thought I'd end up quoting Edward Teller, but he did get it right when he said, "There's no system foolproof enough to defeat a sufficiently great fool."

Future ALWRs, according to Stahlkopf, would be smaller than current models, with fewer parts to break down. For example, a typical 1,000-megawatt nuclear plant with an LWR has 30,000 to 40,000 valves. Many of these valves are complex subsystems requiring a motor, controls, remote readouts, and other equipment. Many of these systems could be eliminated, Stahlkopf contends, because simpler systems are being developed. New ALWRs would be assembled from shop-fabricated modular components, making them cheaper for utility companies to buy. Instead of pumps for emergency cooling water, ALWRs would use gravity; larger supplies of emergency cooling water would be available; larger heat-transfer surfaces would conduct heat from the core more quickly; and the power density of fission cores would be decreased and easier to control.

Westinghouse, in conjunction with Burns and Roe, an architectural and engineering firm that designs nuclear power plants, is also developing a safer ALWR. It's called the AP-600. "We've proved that this reactor is technically feasible and economically competitive with coal and oil," says Joseph Sudol, project manager for the reactor at Burns and Roe. By the mid-Nineties Westinghouse and Burns and Roe expect to start building these reactors—and they think they'll have buyers. "We've had expressions of interest," Sudol says.

DESIGNER REACTORS

The designs of the present, LWRs and ALWRs, may not be those of the future. Three other types of reactors that proponents claim to be "inherently safe" go by the names of integral fast reactor (IFR), high-temperature gas-cooled reactor (HTGR), and process inherent ultimate safe reactor (PIUS).

As a prototype, the IFR has been around for years, although there are no commercial IFRs in this country. The volatile components of the integral fast reactor are immersed in a coolant of liquid-sodium metal. Because the coolant is a metal, it draws heat away from a hot core more effectively. A second sodium loop carries heat from the core to the steam generator. Even if the reactor pumps fail, the sodium will still carry away the heat by natural convection. The IFR uses fuel rods made of a metallic alloy (uranium and plutonium in a wrapping of zirconium) that expands if the temperature in the reactor gets too high, stopping the fission reaction. The standard reactor uses ceramic oxide fuels that retain more heat than metallic fuels and do not easily expand when heated.

Proponents of the IFR brag about its "inherent safety." One IFR design is being perfected at the Argonne National Laboratory in Idaho Falls, Idaho. In 1986 researchers tested several times the reactor's ability to shut itself down in a major accident. After conducting a "loss-of-flow test," a simulated total electrical blackout, Yoon Chang, general manager of the Argonne's IFR program, concluded, "Spectacular successes." As reported in many newspapers, including *The New York Times* and the *Los Angeles Times,* as well as by the Associated Press and United Press International, testers cut power to the reactor's sodium pumps and even disconnected all emergency electrical power, preventing the reactor's control rods from dropping into the core.

The temperature of the sodium coolant rose rapidly, Chang explains, causing the core of the reactor to expand, shutting down the fission reaction—all without operator action. "Simple physics," says Chang. As the reactor core and its fuel rods expanded from the heat, the uranium elements moved away from one another; the nuclear chain reaction was gradually reduced and halted. The test, Chang says, successfully simulated what would happen in a commercial IFR reactor. Rockwell International and General Electric have al-

ready developed two commercial designs for "inherently safe" sodium-cooled reactors. "Some utility leaders have a vision for the future," Chang says. "To maintain the nuclear option in the long run, we need to develop this new generation of reactors."

Robert Pollard believes the scientists at Argonne claim too much for their "spectacular" experiments, which tested a loss of coolant flow but not a loss of the actual coolant itself—what Pollard calls the "worst-case scenario." As spokesman and nuclear safety engineer with the Union of Concerned Scientists, an organization opposed to the use of nuclear energy and weaponry, Pollard has called for a phaseout of all U.S. nuclear power plants. According to Pollard, Argonne's IFR design is being touted as safe, but it's not any safer than the reactor at Three Mile Island.

BALLS OF FIRE

A safer alternative to the "inherently safe" IFR is the high-temperature gas-cooled reactor. So claims Richard Dean, senior president of reactor programs for General Atomics in San Diego (formerly called GA Technologies). In this design the coolant, helium gas, is pumped down through the core and then to a steam generator. The fuel: uranium sealed in layers of pyrolytic carbon and silicon carbide. The one-millimeter balls are molded into graphite rods, which are then inserted into a hexagonal graphite box. A total of 660 boxes is inserted into the reactor to form the core. When it is time to refuel, the individual boxes are removed and replaced. The advantage of using graphite, the researchers claim, is that it withstands intense heat, the exact type of heat buildup that occurs if the reactor's cooling systems fail. As fuel heats up, its properties change, and fission stops. As an added safety measure, balls made of boron can be dropped into the core. Because boron absorbs neutrons, it kills the chain reaction. Heat produced in the core after a shutdown radiates to the reactor vessel and is carried away by natural air convection.

"The modular HTGR design we're working on is the only 'inherently safe' reactor that can take a loss-of-coolant accident—a LOCA—and not result in fuel failure," says Dean. "Our graphite microspheres can take a LOCA. We have no metal components in the core because metals cannot withstand high temperatures for very long. Graphite can, and so radioactive fission products cannot escape." (Water reacts with graphite. In the Chernobyl hybrid reactor, such a reaction created steam containing radioactive elements. The steam was released into the atmosphere after the explosion. In the HTGR design, however, the coolant is helium gas and not water.)

Dean anticipates another potential disaster: withdrawing the control rods from the reactor core. In many conventional reactors, if the control rods are taken out, the result could be a runaway chain reaction, resulting in a meltdown. "If an HTGR is running at full power and the control rods are suddenly withdrawn, our reactor shuts down. Liquid-metal reactors, however, are very sensitive to that kind of accident." Light-water reactor advocates note that LWRs also shut down when the control rods are withdrawn.

Three HTGR reactors are in operation, one at Fort St. Vrian in Colorado and two (called AVRs) in West Germany. (A small commercial HTGR ran at the Peach Bottom nuclear facility on the Susquehanna River about 40 miles from Philadelphia between 1968 and 1974.) While the Colorado reactor has been plagued by design and performance problems, the AVR design in West Germany has been running since 1968. The fuel in the German AVRs is uranium, which is sealed inside small graphite balls. Some 360,000 spheres lie on the bottom of the reactor. New fuel spheres are fed into the core from the top; spent ones are removed from the bottom. "In 1971 the Germans ran a loss-of-cooling test on the AVR identical to the one that Argonne did with its IFR in 1986," Dean says. "The AVR shut itself down, too!"

Internationally there is strong interest in HTGRs. The Chinese have included the reactor in their nuclear power program; Italy is considering HTGRs; Spain, Japan, and Bangladesh are working with General Atomics; the Soviet Union, which has its own HTGR program, has recently expressed interest in the West German AVR design. "We hope," says Dean, "to complete a comprehensive plan this year for developing the next generation of HTGRs."

BLINDLY INTO THE BREACH

None of these designs are as futuristic as the process inherent ultimate safe reactor, brainchild of the Swedish company ASEA-ATOM. Touted as "inherently safe" by its designers, the PIUS light-water reactor would be completely submerged in a pool of cool water laced with boron. The

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reactor core, enclosed inside the containment vessel, would have its own supply of boron-free warm water. The two water supplies would not mix, and no mechanical values would separate them because PIUS would rely on the principle of thermal layering: The higher-density borated water would stay below the warmer, lower-density core water; the density difference and the height of the reactor vessel would cause a pressure difference of about six pounds per square inch. Unless other energy was supplied, the borated water would flow into the core through pumps. If the pumps stopped, the borated water would surge into the core, absorb neutrons, and stop the fission reaction. No human intervention would be needed.

Should a PIUS reactor fail for any reason—electrical blackout, operator error, terrorist attack, conventional war—it would automatically shut itself off and cool itself down. A PIUS reactor would cool for a week by natural convection before more water would need to be added. And that could be done by a fire engine hookup to a simple hydrant-type connection. It would take only a few minutes.

PIUS has won praise from Alvin Weinberg, one of the new-religion people. "Short of a direct hit by a nuclear warhead, PIUS ought to be invulnerable to acts of sabotage and war," Weinberg wrote in the *Bulletin of The Atomic Scientists* in 1986. What's more, he added, PIUS "appears to have as close to a zero probability of a disabling accident as I can imagine."

Engineers agree that PIUS *is* an elegant design, but that's all—only a design. It's still on the drawing boards. Not even a prototype has been constructed, and one must be constructed to demonstrate its claims. "I think there have been some small-scale lab tests of the hydraulics," says Francis Patti, chief nuclear engineer at Burns and Roe. "But we don't have the body of research, including full-scale tests, that would demonstrate the validity of the principle behind PIUS." EPRI's Stahlkopf adds, "We've done an in-depth study of the PIUS design. The thought is noble, but so far it isn't an efficient power-producing system that's also economical." The old-timers are simply not convinced.

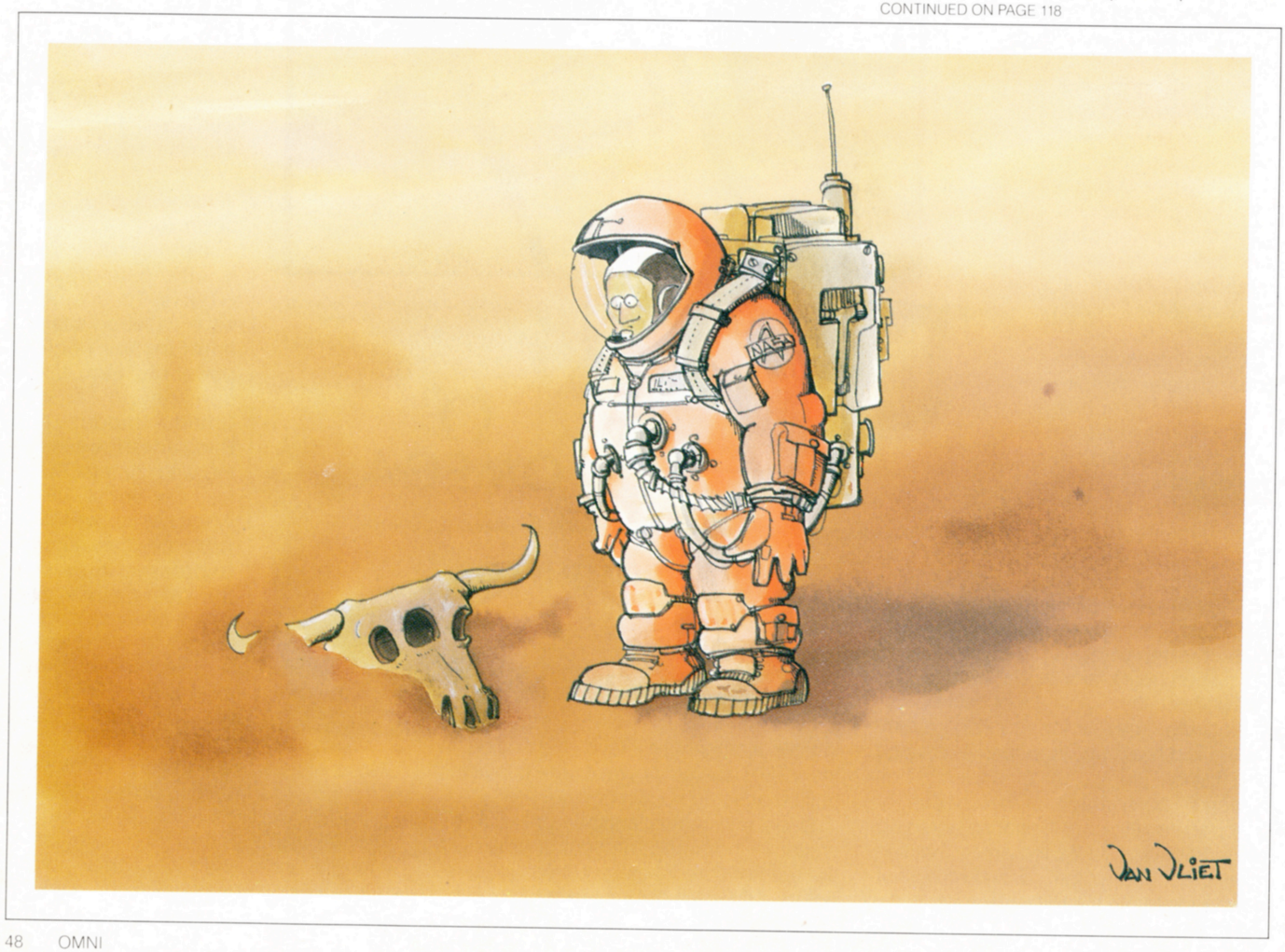
COME AGAIN?

Is a Second Coming possible for the nuclear power industry? Some people fervently hope not. No reactor, they say, can be made safe enough. "I never thought I'd end up quoting Edward Teller," laughs well-known antinuclear activist Amory Lovins, "but he did get it right when he said, 'There's no system foolproof enough to defeat a sufficiently great fool.' " It's hardly surprising that Lovins is unimpressed by claims that nuclear reactors can be made inherently safe. "When you claim you have an inherently safe design, you're transferring the requirement for perfection from the operators to the designers," he says. "If the designers were angels or robots, I'd feel better about the likelihood of success. But designers are as fallible as anyone else."

Ultimately, whether or not the nuclear power industry makes a comeback will probably not depend on which reactor design becomes the industry standard. The average person on the street doesn't know the difference between a light-water reactor and a gas-cooled reactor. But the average person's opinion is very important to the future of nuclear power, which raises difficult questions: Does the average person even care? What is the public's perception of nuclear power today? Is nuclear power good or bad?

According to an October 1987 Gallup poll, 77 percent of Americans believe nuclear energy is important in meeting the country's future electricity needs, and 75 percent believe that the nation's need for nuclear energy will increase in the years ahead. The Gallup results are consistent with recent findings by Cambridge Reports, Inc., another major national polling organization. In August 1987 Cambridge Reports found 79 percent of Americans express the view that nuclear energy will be important in meeting future U.S. electricity needs. When Americans, however, were asked, "If a new power plant were

CONTINUED ON PAGE 118



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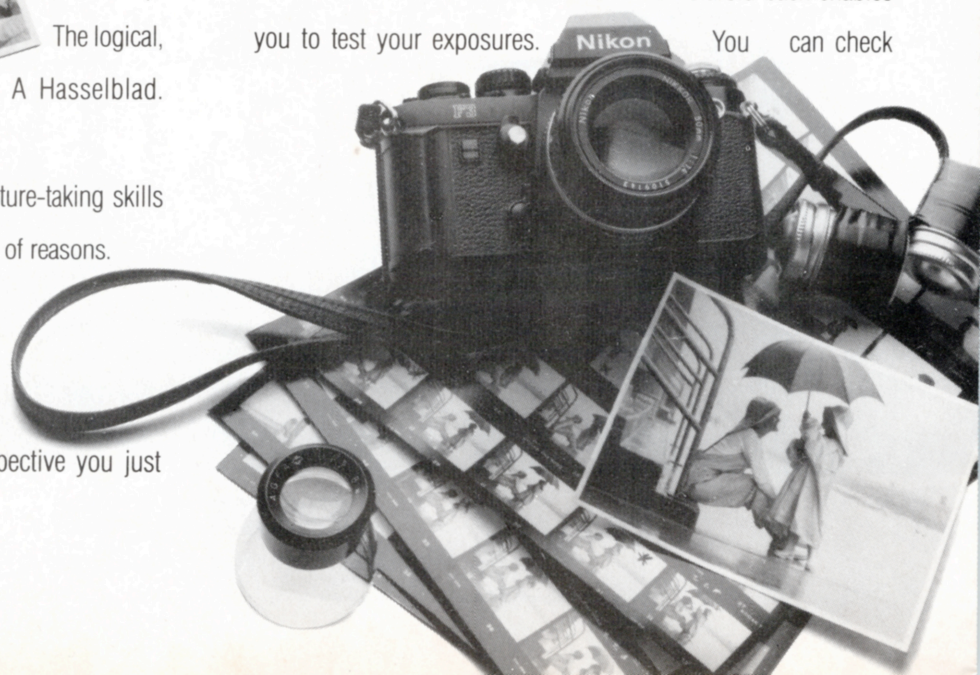

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FICTION

If you wish hard enough for the thing you want most in the world, you just might get it—and change your whole life

LIFE OF BUDDHA

BY LUCIUS SHEPARD

Whenever the cops scheduled a raid on the shooting gallery to collect their protection money, old cotton-headed Pete Mason, who ran the place, would give Buddha the day off. Buddha rarely said a word to anyone, and Pete had learned that cops were offended by silence. If you didn't scream and run when they busted in, if like Buddha you just sat there and stared at them, they figured you were concealing a superior attitude, and they then tended to get upside your head.

They had beaten Buddha half to death a couple of times for this very reason, and while Buddha hadn't complained (he never complained about anything), Pete did not want to risk losing such a faithful employee. So on the night prior to the September raid, Pete went downstairs to where Buddha was nodding on a stained mattress by the front door and said, "Why don't you hang out over at Taboo's place tomorrow? Police is comin' round to do they thang."

Buddha shook himself out of his nod and said, "Talked to him already. Johnny Wardell's gon' be over sometime makin' a buy, but he say to come ahead anyway." He was a squat black man in his late thirties, his head stone bald, with sleepy, heavy-lidded eyes and the beginnings of jowls; he was wearing chinos stippled with blood from his last fix, and a too-small gray T-shirt that showed every tuck and billow of his round belly and womanly breasts. Sitting there, he looked like a Buddha carved from ebony that somebody had outfitted with Salvation Army clothes, and that was why Pete had given him the name. His real name was Richard Damon, but he wouldn't respond to it anymore. Buddha suited him just fine. "Beats me why Taboo wanna do business with Johnny Wardell," Pete said, hitching his pants up over his ample stomach.

PAINTING BY BOB VENOSA

"Sooner or later Wardell he be gettin' crazy all over a faggot like Taboo . . . y'know?"

Buddha grunted, scratched the tracks on his wrist, and gazed out the window beside the front door. He knew Pete was trying to draw him into a conversation, and he had no intention of letting himself be drawn. It wasn't that he disliked Pete; he liked him as much as anyone. He simply had no opinions he wanted to share; he had cultivated this lack of opinion, and he had found that the more he talked, the more opinions came to mind.

"You tell Taboo from me," Pete went on, "I been livin' in Detroit more'n sixty years, and I done business wit' a lotta bad dogs, but I ain't never met one meaner than Wardell. You tell him he better watch his behavior, y'understan'?"

"Awright."

"Well . . ." Pete turned and with a laborious gait, dragging his bad leg, mounted the stairs. "You come on up 'round two and get your goodnighter. I'll cut ya out a spoon of China White."

"'Preciate it," said Buddha.

As soon as Pete was out of sight, Buddha lay down and stared at the flaking grayish-white paint of the ceiling. He picked a sliver of paint from the wall and crumbled it between his fingers. Then he ran the back of his hand along the worn nap of the runner that covered the hallway floor. All as if to reassure himself of the familiar surroundings. He had spent the best part of fifteen years as Pete's watchdog, lying on the same mattress, staring at that same dried-up paint, caressing that same runner. Before taking up residence on the mattress, he had been a young man with a future. Everybody had said, "That Richard Damon, he's gon' be headlines, he's gon' be *Live at Five*, he's gon' be *People* magazine." Not that he had started out different from his peers. He'd been into a little dealing, a little numbers, a little of whatever would pay him for doing nothing. But he'd been smarter than most and had kept his record clean, and when he told people he had his eye on the political arena, nobody laughed. They could see he had the stuff to make it. The trouble was, though, he had been so full of himself, so taken with his smarts and his fine clothes and his way with the ladies, he had destroyed the only two people who had cared about him. Destroyed them without noticing. Worried his mama into an early grave, driven his wife to suicide. For a while after they had died, he'd gone on as always; but then he'd come up against guilt.

He hadn't known then what that word *guilt* meant; but he had since learned its meaning to the bone. Guilt started out as a minor irritation no worse than a case of heartburn and grew into a pain with claws that tore out your guts and hollowed your heart. Guilt made you sweat for no reason, jump at the least noise, look behind you in every dark place. Guilt kept you from sleeping, and when you did manage to drop off, it sent you dreams about your dead, dreams so strong they began to invade your waking moments. Guilt was a monster against which the only defense was oblivion. . . . Once he had discovered that truth, he had sought oblivion with the fervor of a converted sinner.

He had tried to kill himself but had not been able to muster the necessary courage and instead had turned to drugs. To heroin and the mattress in the shooting gallery. And there he had discovered another truth: that this life was in itself a kind of oblivion, that it was carving him slow and simple, emptying him of dreams and memories. And of guilt.

The porch steps creaked under someone's weight. Buddha peered out the window just as a knock sounded at the door. It was Marlene, one of the hookers who worked out of Dally's Show Bar down the block: a pretty cocoa-skinned girl carrying an overnight bag, her breasts pushed up by a tight bra.

Her pimp—a long-haired white kid—was standing on a lower step. Buddha opened the door, and they brushed past him. "Pete 'round?" Marlene asked.

"Guilt started out as an irritation no worse than heartburn and grew into a pain with claws that tore out your guts and hollowed your heart. Guilt was a monster; the only defense was oblivion."

Buddha pointed up the stairs and shut the door. The white kid grinned, whispered to Marlene, and she laughed. "John think you look like you could use some lovin'," she said. "What say you come on up, and I'll give you a sweet ride for free?" She chucked him under the chin. "How that sound, Buddha?"

He remained silent, denying desire and humiliation, practicing being the nothing she perceived. He had become perfect at ignoring ridicule, but desire was still a problem: The plump upper slopes of her breasts gleamed with sweat and looked full of juice. She turned away, apparently ashamed of having teased him.

"Take it easy now, Buddha," she said with studied indifference, and hand-led the white kid up the stairs.

Buddha plucked at a frayed thread on the mattress. He knew the history of its every stain, its every rip. Knew them so thoroughly that the knowledge was no longer something he could say: It was part of him, and he was part of it. He and the mattress had become a unity of place and purpose. He wished he could risk going to sleep, but it was Friday night, and there would be too many customers, too many interruptions. He fixed his gaze on the tarnished brass doorknob, let it blur until it became a greenish-gold sun spinning within a misty corona. Watched it whirl around and around, growing brighter and brighter. Correspondingly his thoughts spun and brightened, becoming less thoughts than reflections of the inconstant light. And thus did Buddha pass the middle hours of the night.

At two o'clock Buddha double-bolted the door and went upstairs for his goodnighter. He walked slowly along the corridor, scuffing the threadbare carpet, its pattern eroded into grimy darkness and worm trails of murky gold. Laughter and tinny music came from behind closed doors, seeming to share the staleness of the cooking odors that pervaded the house. A group of customers had gathered by Pete's door, and Buddha stopped beside them. Somebody else wandered up, asked what was happening, and was told that Pete was having trouble getting a vein. Marlene was going to hit him up in the neck. Pete's raspy voice issued from the room, saying, "Damn it! Hurry up, woman!"

Getting a vein was a frequent problem for Pete; the big veins in his arms were burned-out, and the rest weren't much better. Buddha peered over shoulders into the room. Pete was lying in bed, on sheets so dirty they appeared to have a design of dark clouds. His freckly brown skin was suffused by a chalky pallor. Three young men—one of them Marlene's pimp—were gathered around him, murmuring comforts. On the night table a lamp with a ruffled shade cast a buttery yellow light, giving shadows to the strips of linoleum peeling up from the floor.

Marlene came out of the bathroom, wearing an emerald-green robe. When she leaned over Pete, the halves of the robe fell apart, and her breasts hung free, catching a shine from the lamp. The needle in her hand showed a sparkle on its tip. She swabbed Pete's neck with a clump of cotton and held the needle poised an inch or two away.

The heaviness of the light, the tableau of figures around the bed, Marlene's gleaming skin, the wrong-looking shadows on the floor, too sharp to be real: Taken all together, these things had the same richness and artful composition, the same important stillness, as an old painting that Buddha had once seen in the Museum of Art. He liked the idea that such beauty could exist in this ruinous house, that the sad souls therein could become even this much of a unity. But he rejected his pleasure in the sight, as was his habit with almost every pleasure.

Pete groaned and twisted about. "Stop that shit!" Marlene snapped. "Want me to bleed you dry?"

They don't brag about their kids,
or make you watch slides of their vacations.

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LOOK WHO'S AVAILABLE THIS MONTH

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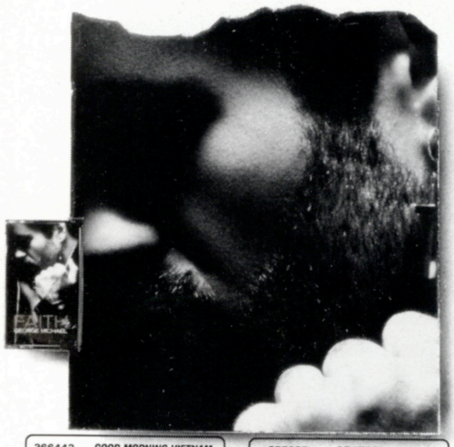

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348318 A&M — THE POLICE EVERY BREATH YOU TAKE... THE SINGLES

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356329 WARNER BROS. — *RANDY TRAVIS* ALWAYS & FOREVER

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357590● ATLANTIC — *TWISTED SISTER* LOVE IS FOR SUCKERS

353946 A&M — BRYAN ADAMS *INTO THE FIRE*

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361451● COLUMBIA — *MICHAEL BOLTON* THE HUNGER

358929† 398925 MCA — ELTON JOHN LIVE IN AUSTRALIA MELBOURNE SYMPHONY ORCH.

353599● CAPITOL — IRON MAIDEN *SOMEWHERE IN TIME*

349571 MCA — *BOSTON* THIRD STAGE

345587● LAURIE — VARIOUS ARTISTS *MILLION DOLLAR MEMORIES*

339903 ELEKTRA — *THE CARS* GREATEST HITS

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Other people closed in around the bed, blocking Buddha's view. Pete's voice dropped to a whisper, instructing Marlene. Then people began moving away from the bed, revealing Pete lying on his back, holding a bloody Kleenex to the side of his neck. Buddha spotted his goodnighter on the dresser: a needle resting on a mirror beside a tiny heap of white powder.

"How you doin'?" Pete asked weakly as Buddha walked in.

He returned a diffident wave, went over to the dresser, and inspected the powder: It looked like a nice dose. He lifted the mirror and headed off downstairs to cook up.

"Goddamn!" said Pete. "Fifteen years I been takin' care of you. Feedin' your Jones, buyin' your supper. Think we'd have a relationship by now." His tone grew even more irascible. "I should never have give you that damn name! Got you thinkin' you inscrutable, when all you is is ignorant!"

Nodding on his mattress in the moonlit dark, feeling the rosy glow of the fix in his heart, the pure flotation of China White in his flesh, Buddha experienced little flash dreams: bizarre images that materialized and faded so quickly, he was unable to categorize them. After these had passed he lay down, covered himself with a blanket, and concentrated upon his dream of Africa, the one pleasure he allowed himself to nourish. His conception of Africa bore no relation to the ethnic revival of the Sixties, to Afros and dashikis, except that otherwise he might have had no cognizance of the Dark Continent. Buddha's African kingdom was a fantasy derived from images in old movies, color layouts in *National Geographic*, from drugs and drugged visions of Nirvana as a theme park. He was not always able to summon the dream, but that night he felt disconnected from all his crimes and passionate failures, stainless and empty, and thus worthy of this guardian bliss. He closed his eyes, then squeezed his eyelids tight until golden pinpricks flowered in the blackness. Those pinpricks expanded and opened into Africa.

He was flowing like wind across a tawny plain, a plain familiar from many such crossings. Tall grasses swayed with his passage, antelope started up, and the gamy smell of lions was in the air. The grasslands evolved into a veld dotted with scum-coated ponds and crooked trees with scant, pale foliage. Black stick figures leapt from cover and menaced him with spears, guarding a village peopled by storytellers and long-legged women who wore one-eyed white masks and whose shadows danced when they walked. Smoke plumed from wart-shaped thatched huts and turned into music; voices spoke from cooking fires. Beyond the village stood green mountains that rose into the clouds, and there among the orchids and ferns were the secret kingdoms of the gorillas. And beyond the mountains lay a vast blue lake, its far reaches fringed by shifting veils of mist in whose folds miragelike images materialized and faded.

Buddha had never penetrated the mists: There was something ominous about their unstable borders and the ghostly whiteness they enclosed. At the center of the lake a fish floated halfway between the surface and the bottom, like the single thought of a liquid brain. Knowing that he must soon face the stresses of the outside world, Buddha needed the solace offered by the fish; he sank beneath the waters until he came face-to-face with it, floating a few inches away.

The fish resembled a carp and measured three feet from its head to its tail; its overlapping scales were a muddy brown, and its face was the mask of a lugubrious god, with huge golden eyes and a fleshy, downturned mouth. It seemed to be regarding Buddha sadly, registering him as another of life's disappointments, a subject with which it was quite familiar, for its swollen belly encaged all the evil and heartache in the world, both in principle and reality. Buddha gazed into its eyes, and the pupils expanded into black funnels that connected with his own pupils, opening channels along which torrents of grief and fear began to flow. The deaths of his wife and mother were nothing compared with the hallucinatory terrors that now confronted him: demons with mouths large enough to swallow planets; gales composed of a trillion dying breaths; armies of dead men and women and children. Their bodies maimed by an infinity of malefic usage. Had he witnessed these visions while awake, he would have been overwhelmed; but protected by the conditions of the dream, he withstood them and was made strong.

And before long he fell asleep in the midst of this infinite torment contained within the belly of the fish in his dream, contained in turn within his skull, within the ramshackle frame house, within the gunshot-riddled spiritual realm of the Detroit ghetto, whose agonies became a fleeting instance of distress—the fluttering of an eyelid, the twitching of a nerve—within the dreamed-of peace of Buddha's sleep.

The shooting gallery was located in the Jefferson–Chalmers district, the section of the ghetto most affected by the '67 riots. Hundreds of gutted houses still stood as memorials to that event, and between them—where once had stood other houses—lay vacant lots overgrown with weeds and stunted trees of heaven. The following afternoon, as he walked past the lot adjoining the shooting gallery, Buddha was struck by the sight of a charred sofa set among weeds at the center of the lot, and obeying an impulse, he walked over to it and sat down. It was the first day of fall weather. The air was crisp, the full moon pinned like a disfigured cameo of bone to a cloudless blue sky. In front of the sofa was a pile of ashes over which somebody

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had placed a grill; half a dozen scorched cans were scattered around it. Buddha studied the ashes, the grill, the cans, mesmerized by the pattern they formed. Sirens squealed in the distance, a metallic clanging seemed to be issuing from beyond the sky, and Buddha felt himself enthroned, the desireless king of a ruined world in which all desire had faltered.

He had been sitting for perhaps an hour when a teenage boy with a freckly complexion like Pete's came running along the sidewalk. Dressed in jeans and a sweatshirt and lugging an immense ghetto blaster. The boy looked behind him, then sprinted across the lot toward Buddha and flung himself down behind the sofa. "You tell 'em I'm here," he said breathlessly, "I'll cut ya!" He waggled a switchblade in front of Buddha's face. Buddha just kept staring at the toppled brick chimneys and vacated premises. A dragonfly wobbled up from the leaves and vanished into the sun dazzle of a piece of broken mirror canted against the ash heap.

Less than a minute later two black men ran past the lot. Spotting Buddha, one shouted, "See a kid come this way?" Buddha made no reply.

"Tell 'em I headed toward Cass," the kid whispered urgently, but Buddha maintained his silence, his lack of concern.

"Y'hear me?" the man shouted. "Did a kid come this way?"

"Tell 'em!" the boy whispered.

Buddha said nothing.

The two men conferred and after a second ran back in the direction from which they had come. "Damn, blood! You take some chances!" said the boy, and when Buddha gave no response, he added, "They come back, you just sit there like you done. Maybe they think you a dummy." He switched on the ghetto blaster, and rap music leaked out, the volume too low for the words to be audible.

Buddha looked at the boy, and the boy grinned, his nervousness evident despite the mask of confidence.

"Ain't this a fine box?" he said. "Fools leave it settin' on they stoop, they deserve to get it took." He squinted as if trying to scry out Buddha's hidden meaning. "Can't you talk, man?"

"Nothin' to say," Buddha answered.

"That's cool. . . . Too much bullshit in the air, anyhow."

The boy reminded Buddha of his younger self, and this disquieted him: He had the urge to offer advice, and he knew advice would be useless. The boy's fate was spelled out by the anger lying dormant in the set of his mouth. Buddha pitied him, but pity—like love, like hate—was a violation of his policy of noninvolvement, an impediment of the emptiness to which he aspired. He got to his feet and headed for the sidewalk.

"Hey!" yelled the boy. "You tell them mothafuckas where I'm at, I'll kill yo' ass!"

Buddha kept walking.

"I mean it, man!" And as if in defiance, as if he needed some help to verbalize it, the boy turned up the ghetto blaster, and a gassed voice blared, "Don't listen to the shuck and jive from Chairman Channel Twenty-five. . . ."

Buddha picked up his pace, and soon the voice mixed in with the faint sounds of traffic, distant shouts, other musics, absorbed into the troubled sea from which it had surfaced.

From the shooting gallery to Taboo's apartment should have been about a twenty-minute walk, but that day—still troubled by his encounter with the boy—Buddha cut the time in half. He had learned that it was impossible to avoid involvement on his day off, impossible not to confront his past, and in Taboo he had found a means of making the experience tolerable, letting it be the exception that proved the rule. When he had first met Taboo seven years before, Taboo's name had been Yancey; he had been eighteen, married to a pretty girl, and holding down a steady job at Pontiac Motors.

"At the center of the lake, a fish floated halfway between the surface and the bottom, like a single thought of a liquid brain. Its face was the mask of a lugubrious god."

Three years later, when he had next run into him, Taboo had come out of the closet, was working as a psychic healer, curing neighborhood ladies of various minor complaints, and through hormone treatments had developed a small yet shapely pair of breasts, whose existence he hid from the world beneath loose-fitting clothes.

Buddha had caught a glimpse of Taboo's breasts by accident, having once entered his bathroom while he was washing up, and after this chance revelation, Taboo had fixed upon him as a confidant, a circumstance that Buddha had welcomed—though he did not welcome Taboo's sexual advances. He derived several benefits from the relationship. For one thing, Taboo's specialty was curing warts, and Buddha had a problem with warts on his hands (one such had given him an excuse to visit that day); for another, Taboo—who dealt on the side—always had drugs on hand. But the most important benefit was that Taboo provided Buddha with an opportunity to show kindness to someone who brought to mind his dead wife. In their solitary moments together Taboo would don a wig and a dress, transforming himself into the semblance of a beautiful young woman, and Buddha would try to persuade him to follow his inner directives and proceed with the final stage of his sex change. He would argue long and hard, claiming that Taboo's magical powers would mature once he completed the transformation, telling Taboo stories of how wonderful his new life would be. But Taboo was deathly afraid of the surgeon's knife, and no matter how forcefully Buddha argued, he refused to pay heed. Buddha knew there had to be an answer to Taboo's problem, and sometimes he felt that answer was staring him in the face. But it never would come clear. He had the notion, though, that sooner or later the time would be right for answers.

It was a beautiful spring day in Taboo's living room. The walls were painted to resemble a blue sky dappled with fluffy white clouds, and the floor was carpeted with artificial grass. In Taboo's bedroom where he did his healing, it was a mystical night. The walls were figured with cabalistic signs and stars and a crescent moon, and the corner table was ebony, and the chairs upholstered in black velour. Black drapes hid the windows; a black satin quilt covered the bed. Muted radiance shone from the ceiling onto the corner table, and after he had fixed, it was there that Buddha sat soaking his wart in a crystal bowl filled with herb-steeped water, while Taboo sat beside him and muttered charms.

Taboo was not in drag because he was waiting for Johnny Wardell to show; but even so he exhibited a feminine beauty. The soft lighting applied sensual gleams to his chocolate skin and enhanced the delicacy of his high cheekbones and generous mouth and almond-shaped eyes. When he leaned forward to inspect Buddha's wart, the tips of his breasts dimpled the fabric of his blousy shirt. Buddha could make out his magic: a disturbance like heat haze in the air around him.

"There, darlin'," said Taboo. "All gone. Your hand back the way it s'posed to be."

Buddha peered into the bowl. At the bottom rested a wrinkled black thing like a raisin. Taboo lifted his hand from the water and dried it with a towel. Where the wart had been was now only smooth skin. Buddha touched the place; it felt hot and smelled bitter from the herbs.

"Wish Johnny'd hurry up," said Taboo. "I bought a new dress I wanna try on for ya."

"Whyn't you try it on now? If the buzzer goes, you can pretend you ain't at home."

" 'Cause I just have to deal wit' him later, and no tellin' what kinda mood Johnny be in then."

Buddha had no need to ask Taboo why he had to deal with Johnny Wardell at all. Taboo's reason for risking himself among the bad dogs was similar to Buddha's reason for retreating from life: He felt guilty for the way he was, and this risk was his self-inflicted punishment.

CONTINUED ON PAGE 112

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ARTICLE

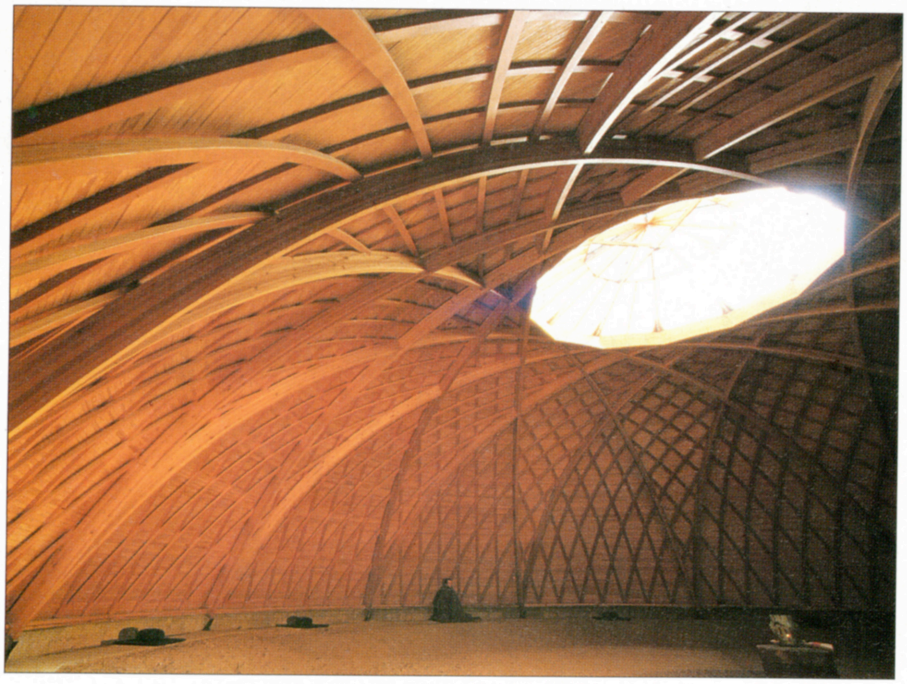
Even geometry can become mystical when the formulas are correct

SPIRIT DWELLINGS

BY JAMAKE HIGHWATER

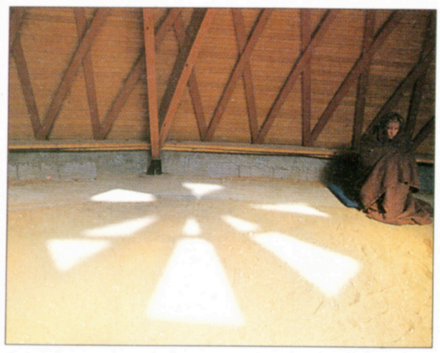
The highway disappears into the farthest horizon of the San Luis Valley in Colorado. It is a narrow black road that cuts an unrelenting straight line through a flat, brown, uninhabited world of starving grasses and leafless scrubs. The long drive from Denver to the tiny town of Crestone (population 56), hidden away in the southwestern tip of the state, is starting to get to me. I have the uncomfortable feeling that I have been summoned to the end of the world. There has not been another automobile or truck for more than an hour. Twice, as I

"It seems as if the chapel's ceiling of intertwined ribs is a gigantic amplifier of the ancient stillness that comes from the earth itself."



speed past ramshackle farms lost among a few trees far from the highway, I see what looks like one or two people. Otherwise I am utterly alone on this endless road, searching for some sign of the lavish settlement called Baca Grande to which I have been invited. *Surely,* I think, *this can't be the location of the Lindisfarne Mountain Retreat, William Irwin Thompson's sanctuary for philosophical meditation.*

Just as I am sure that my journey is some kind of senseless joke, I slam on the brakes in amazement. At the edge of this deserted highway an ultramodern structure stands incongruously in the midst of the desolation. A sign reads BACA GRANDE VISITORS CENTER. But from the dust on the windowpanes, I suspect it has not had a visitor in a very long time. As I get back into the car, I ponder whether to call it a day and turn back toward civilization, when I notice a road sign pointing into thin air. Peering into the great, vacant distance where the sign indicates, I step on the gas and turn down an asphalt lane that



branches off the highway and meanders across the wide valley toward the Sangre de Cristo Mountains, those great humps of earth that tower into Crestone Peak on one side and Kit Carson Peak on the other.

By now it is dusk. At this altitude (8,000 feet) the night comes down so suddenly that it seems to devour the sun. Soon I will be alone in an entirely lightless world, miles from anything and anyone. I am feeling deeply troubled by this thought and by an illogical fear of the landscape itself, when I once again stop the car in amazement. The fearsome mountains that rise before me are gradually turning a rich bloodred. My fears turn to wonderment. What had seemed a forbidding place is now a world of natural power. I speed toward the bleeding mountains until I am almost in their foothills. Then yet another surprise confronts me in the last light of day: An artificial lake appears on my left, surrounded by a highly manicured golf course; then low modern bungalows and a resort motel; and finally the Baca Grande settlement.

Like a dreamer disappointed to awaken into a simpler reality than his dream, I know that I have arrived at my destination.

"The Ute Indians regard the San Luis Valley as the center of the world," Thompson tells me the next day as he shows me around the Lindisfarne settlement. As head of Lindisfarne, an international organization dedicated to spiritual transformation and other New Age concerns, Thompson had looked for several years for the right place for the society's meditation center. "This valley was perfect," he explains. "It has always been a holy place. The medicine men of the Ute tribe believe that it was here that 'time began.' "

From our position on the gentle slope where Lindisfarne is located, we peer over the magical, wide valley in silence. The sun burns down on the flatlands, casting deep shadows upon the naked upheaval of stone that forms the surrounding mountains, so high above us that they are capped with snow even in August.

Thompson guides me to his work in progress—the Lindisfarne chapel. As we walk into a circular structure of rock and wood, it seems as if the chapel's domed

The greatest structures of the ancient world were built using principles of sacred architecture: The pyramids (preceding pages), the Parthenon (top right), and Stonehenge (bottom right) are three examples. Today a small group of architects still calls on those principles in their work. The recently constructed chapel at the Lindisfarne Mountain Retreat in Colorado (top left and center) is one example.

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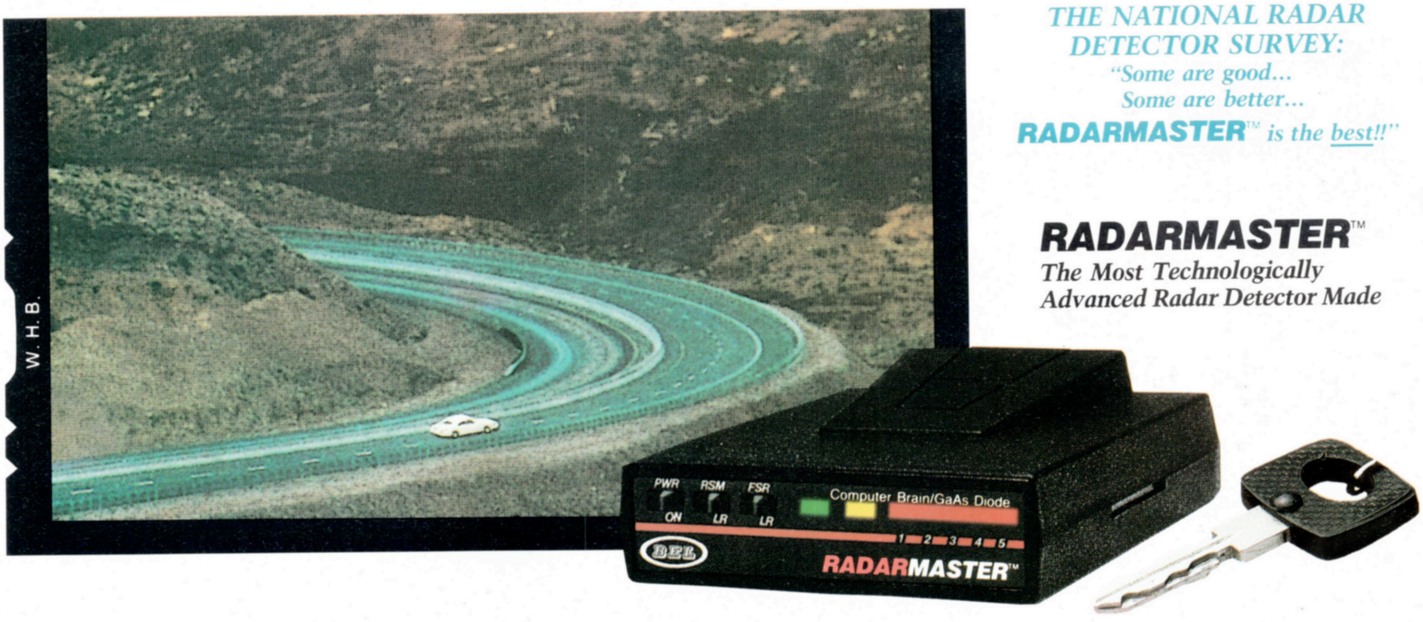

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ceiling of intertwined ribs and timber is a gigantic amplifier of the ancient stillness that comes from the earth itself. I feel the same mixture of delight and fear that I had felt in the Paleolithic caves of Spain or in central Anatolia's underground cities of Cappadocia or at Chartres Cathedral in France. There the massive buttresses support a similar intertwining of stone, not wooden, ribs. Indeed, throughout the Lindisfarne retreat—a series of handsome structures built of natural materials—the combination of earth and architecture results in an intense mood of sacredness.

Thompson's round, bearded face is transformed by a lavish smile as he realizes my amazement. "The chapel is rather special," he murmurs into the deep silence. "It's not like that masculine Air Force Academy Chapel in Colorado Springs, which expresses the spirit of technology and the desire to soar above the earth. The sacred is seen here as immanent *in* nature and not in a condition of escape from it."

Though still under construction, the form of the chapel is vividly clear. It is somehow much larger in mind than in reality: a mere 60 feet in diameter and 18 feet in height, nestling into the ground just below the surface, surrounded by a rich landscape. The timbers of the roof and ceiling are interwoven like a basket. "I wanted the chapel to be spiritual but not religious, sacred but not sacerdotal [relating to the priesthood]," Thompson explains. "To build a chapel that is not a church is a paradox. I needed some help."

Help came from several experts in sacred architecture, a tradition that draws on the principles of ancient geometry in the design of spaces. The pyramids, the Parthenon, and almost all the Romanesque and Gothic cathedrals of Europe were designed using the philosophy of sacred architecture formulated by the "mystic mathematicians" of antiquity. The Greek philosopher Pythagoras is probably the best known of those early theorists. Like thinkers in other cultures before him, Pythagoras saw an underlying unity or harmony in the universe and attributed it to basic, unchanging forms and numbers. These perfect forms, he believed, could be made visible through mathematical formulas and geometric renderings. In turn, those calculations could be applied to such concrete forms as buildings and works of art. As Robert Lawlor, one of today's theorists of sacred architecture, explains: "Geometry is a way by which the essential creative mystery is rendered visible. The passage from the unmanifest, pure, formal idea to the 'here-below'—the world that spins out from that original divine stroke—can be mapped out by geometry."

The geometry through which the ideal world can be represented is anything but simple. Indeed, to the untutored it may seem like some sort of geometric numbers game in which squares become circles; spirals evolve from triangles; and hexagons, proportions, and numbers are interwoven to represent spiritual concepts like the Holy Trinity or cosmic fire. The numerology associated with sacred architecture is equally mystical. Odd numbers are considered masculine; even numbers, feminine. The number 1 is associated with a vertical line and connotes the phallus, fire, and ascending spiritual rays. The number 2 is found in a horizontal line and is associated with water, matter, and earth. Together these active and passive principles are envisioned in the numbers 3 and 4 and are symbolized in the triangle and the square. The triangle is also associated with the Trinity of God as well as with the most mystical of all architectural shapes, the pyramid. The square represents terrestrial life and the base of the pyramid. Seven is the most sacred number because it represents the principles of life itself, the sum of 3 (male) and 4 (female).

The philosophy behind sacred architecture had an immense impact on some of the leading artists and architects at the turn of this century. Many groups emerged, such as the Theosophical Society of Helena Blavatsky and the Anthroposophical Society of Rudolf Steiner, which combined religious teachings with geometry and numerology. In the past few years sacred architecture has emerged as a popular topic, especially among New Age groups. Workshops and lectures have drawn many artists and craftspeople. Michele Zackheim, for example, has created an unusual, transportable "temple" utilizing principles of sacred geometry. Her Tent of Meeting, which will be in San Francisco in June and July, is a huge (40 feet by 25 feet) Bedouin-like structure with interior walls lavishly painted with some 250 vignettes taken from religion and folklore. "The tent," she explains, "tends to amplify whatever concept a person has of God. It's a combination of color and light; it moves and seems almost alive. A lot of people think of it as a sacred place."

"To the untutored, sacred geometry may seem like some sort of numbers game in which squares become circles, spirals evolve from triangles, and proportions represent spiritual concepts."

Sculptor David Barr also incorporates some concepts of sacred architecture in his art. One of his works is a model of the earth that encases a huge geometric form called a tetrahedron. Its four equally spaced points pierce the globe's surface at Easter Island, South Africa, Greenland, and New Guinea. The project might have ended with the model, but Barr believes art should be "manifest" and applied his model to the actual earth as if an invisible tetrahedron spanned the inside of the earth with its four outer corners just barely protruding from the ground. He and his assistants traveled to the four selected points to implant small marble pinnacles.

"When I look at the ancient world, at all the stone alignments and sites like Stonehenge," says Barr, "I see the works of people who believed that the earth and cosmos are sacred. They were plugging into that with everything they made. That's what I'm trying to do."

This renewed interest in sacred architecture has supplied Thompson with any number of interested workers to help him build the Lindisfarne chapel. Architect Michael Baron, for instance, first came to Lindisfarne to attend a lecture on sacred architecture, then stayed on to work on the chapel. "The ceiling sort of built itself," he says as he climbs to the margin of the dome and embraces one of the massive beams that rise in a majestic curve to the highest point of the ceiling. His gesture is filled with pleasure and reverence.

Lawlor had urged Thompson to forgo ornamentation in the chapel. "No decoration, only proportion," he said. "I liked that," Thompson explains, "because I realized that the principles of sacred geometry lie above and behind all temples, from Islamic mosques to Shinto shrines and Gothic cathedrals. If the geometry were true and correct, then anyone entering our chapel—no matter what their religion—would feel the sacred calling of the place and wish to sit in silence. It is the geometry at the heart of sacred architecture that gives life and purpose to the chapel."

I have been hearing a great deal about sacred architecture, and frankly, I have been a bit disturbed by the tone of self-righteousness that surrounds many of the discussions. At the Graduate School of Architecture at Columbia University, where I teach, people are very critical of what they call "the cult of sacred architects." To find out more about these architects, I contacted Keith Critchlow, perhaps today's best-known architect of the sacred.

Critchlow, who designed Lindisfarne chapel, gives frequent lectures both in the United States and in Europe. Interestingly, he came to sacred architecture not through science and formal mathematics but through studies in art. A graduate of the Royal College of Art in London, where he is now supervising doctoral candidates, Critchlow is the vice-chairman of the Research into Lost Knowledge Organization Trust, which, according to its literature, studies standing stones and other Neolithic structures.

Critchlow, like other sacred architects past and present, firmly believes that "there are architectural principles that transcend

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different cultural expressions. These are based on elemental and primordial factors and demonstrate how structure on the physical level is integral with structure on the metaphysical level."

I was beginning to see that it was this overriding belief in transcendent forms that makes people uneasy. Even adherents of sacred architecture have sometimes found the theory too inflexible. Stage designer Rachel Fletcher, a former student of Critchlow, for instance, was at Lindisfarne when Thompson decided to build the chapel. But now she regards the ideal forms of sacred architecture as metaphors rather than as representations of fixed, eternal truths. "I study geometry because I want to get a better grasp of a knowable world of ordered relationships," she says. "The fact—and the wonder—is that every pursuit leads inevitably and mysteriously not to the known but to the unknown." This ambiguity and otherworldliness, she believes, "may be what saves geometry from the threat of fundamentalism and fascism—human inclinations that lurk in every shadow of every idealized philosophy."

Thompson has also had problems with the sometimes-rigid ideological stance of many sacred architects. "A few of the geometers have gotten into a kind of crypto-fascism that makes me politically uneasy," he explains. "You can't just come up with some cultish symbolism of numbers and call it the absolute and only truth. It's like a private code known only by an elite, and everybody else is wrong. That's fascist. It can turn into some sort of Boys' Club of the Mysteries of the Sacred Geometry for Theocratic Initiates. That doesn't work for me. I'm just too Walt Whitmanesque for that kind of attitude."

I also had the opportunity to discuss sacred architecture with James Hillman, one of today's leading Jungian analysts. Hillman understands the power architecture has to influence people's feelings. "Geometry is as good a god as any other," he says, "but to claim it is the one and only true god is quite another matter. As I see it, the tendency of sacred geometers is to separate the sacred from the secular, which just makes things worse. . . . The eye must not be forced into Euclidean geometry. This just abstracts one's feelings and tends to create dissociation, which is already at the heart of our emotional problems."

There is little doubt, however, that structures based on principles of sacred architecture do, for whatever reasons, move people. Michael Baron reports that people who enter the Lindisfarne chapel for the first time have occasionally cried. "They find it touches something very familiar inside them," he explains. "Others don't say a word; they sense the sacredness of the place. They may not be sure what's going on, but they are affected by it."

This uncertainty about why a building touches us may stem from our evolutionary past. Human beings, after all, are not really house makers. We're nomads who tend to use available spaces for shelter. We seem to have come to architecture rather late, unlike many species—ants and bees, for instance—that are builders by nature. We had to learn how to be builders, and we're not yet sure how to instill our structures with meaning. Indeed we may be better at recognizing the sacred in a rock than at fabricating structures that produce an atmosphere of sacredness. Perhaps that is why we revert to systems of mathematics and geometry in our efforts to construct our holy places.

The meaning we see in the world is probably more a reflection of ourselves than of some fixed and final truth. As Loren Eiseley put it in his book *The Firmament of Time*, "Man's quest for certainty is, in the last analysis, a quest for meaning. But the meaning lies buried within himself rather than in the void he has vainly searched for portents since antiquity."

Eiseley's theme of an interior quest for meaning is externalized as a vision of architectural space by the British scholar John Michell. "The marks people make on the group reflect the philosophy of the time," he explains. "The groves and temples of Arcadia, the radiating avenues of the imperial center, the neatly ordered municipal garden, and the spoils and affluence of industrial rapacity are each the product of a certain cosmology, a certain view of the nature of the universe and its relationship to men. On the face of the landscape can be seen the effects of the former sacred view of the earth and of the contrasting view now prevailing."

All of the structures built by humankind are expressions of who we are, for all reflect the mentality of the people who produced them. Each of us projects upon the world the ideal—the model paradise—that embodies our vision of ourselves and the cosmos. That vision changes from time to time and from place to place. If it is not eternal, it is nonetheless significant as a metaphor of our minds. Accordingly, the temple is sacred because we envision it to be sacred. But is that sacredness found in nature, or is it something we bestow upon the world as an act of faith and imagination? Perhaps we will never know.

Editors' Note: Since Jamake Highwater wrote this piece, Thompson has left the Lindisfarne Mountain Retreat to work on other projects. The chapel has been completed, however, and is currently being used as a meditation center for students of the Dharma Fanga Zen Center, based in Santa Fe, New Mexico.

"Pretend you don't notice him."

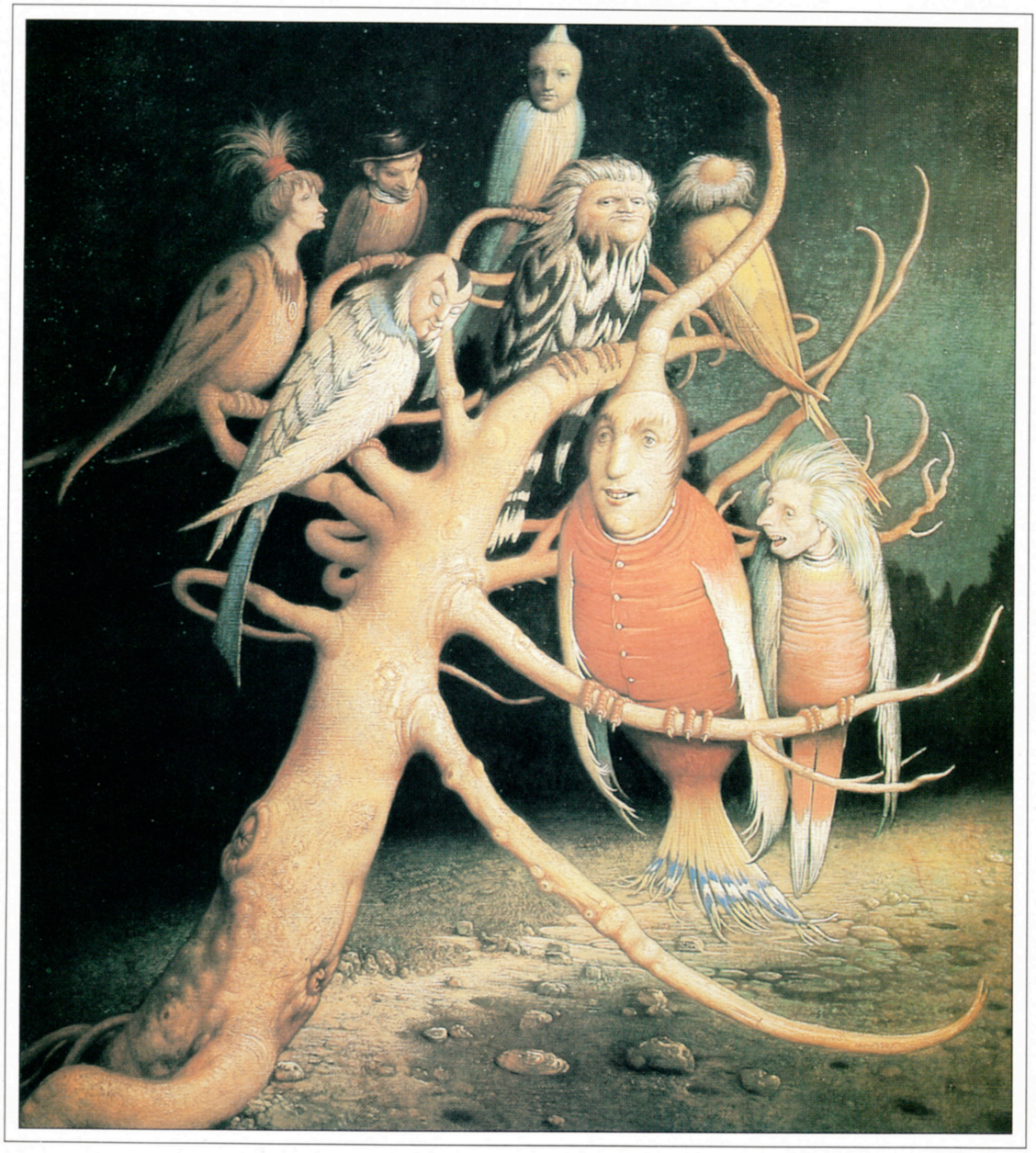
c. Verlinde

For most people, fairy tales
are just make-believe. But not to those of us
who live in your fantasies

MIXED MARRIAGES

PAINTINGS BY CLAUDE VERLINDE

I married a jackass. This may sound like a remark you'd expect from half the nation's seasoned brides, but in my case, it's a fact. Like many cultures, Uphasia had arranged marriages (don't think this cozy coupling was my doing). Not that Jack wasn't a dashing beast, it's just that my heart was bound to a young man of Banbury descent. Although of little substance, he was honest through and through. My ever-elegant and innovative mother announced the marriage decision would be based on logic—she'd weigh what each family had to offer. Little Twit, my younger brother, did his best to emulate my prospective mate, donning the large ears and long tail. Mother sat in for me.



In her knowing way, Mother concluded the offspring would likely resemble our side of the family. It was scientific and settled. As for the rest of the relatives, they were more than pleased. Having few roots and a less-than-impressive family tree, they flew at the opportunity to branch out into an established pack. As celebrations are rarely held here—it's hard with such diverse diets—no one missed the wedding feast, even those who were deliberately uninvited, like Uncle Omen. It was a lovely, if not stark, ceremony. Jack was happy as a lark; I would have been happier to expose him for the animal he really was, rather than exposing myself, but there was no bucking tradition here.

C. Yer

Blissful days followed, as did the inevitable birth of an heir. Although the Gourds, on my father's side, did their best in the delivery room, the indiscretions of my gardening days were unearthed. Rather than put poor Jack through the torment of knowing his son would be a vegetable all his life, I fled. To my shear delight, I met a wonderful man with whom I moved in. My future mother-in-law, being well-bred, doesn't feel that it's kosher to live together, so she sheepishly asked if she could shop for his wedding coat. She desperately wanted him wed, as she holds him responsible for the flock's unmanageable increase. But I feel she's only crying wolf.—Nina Guccione

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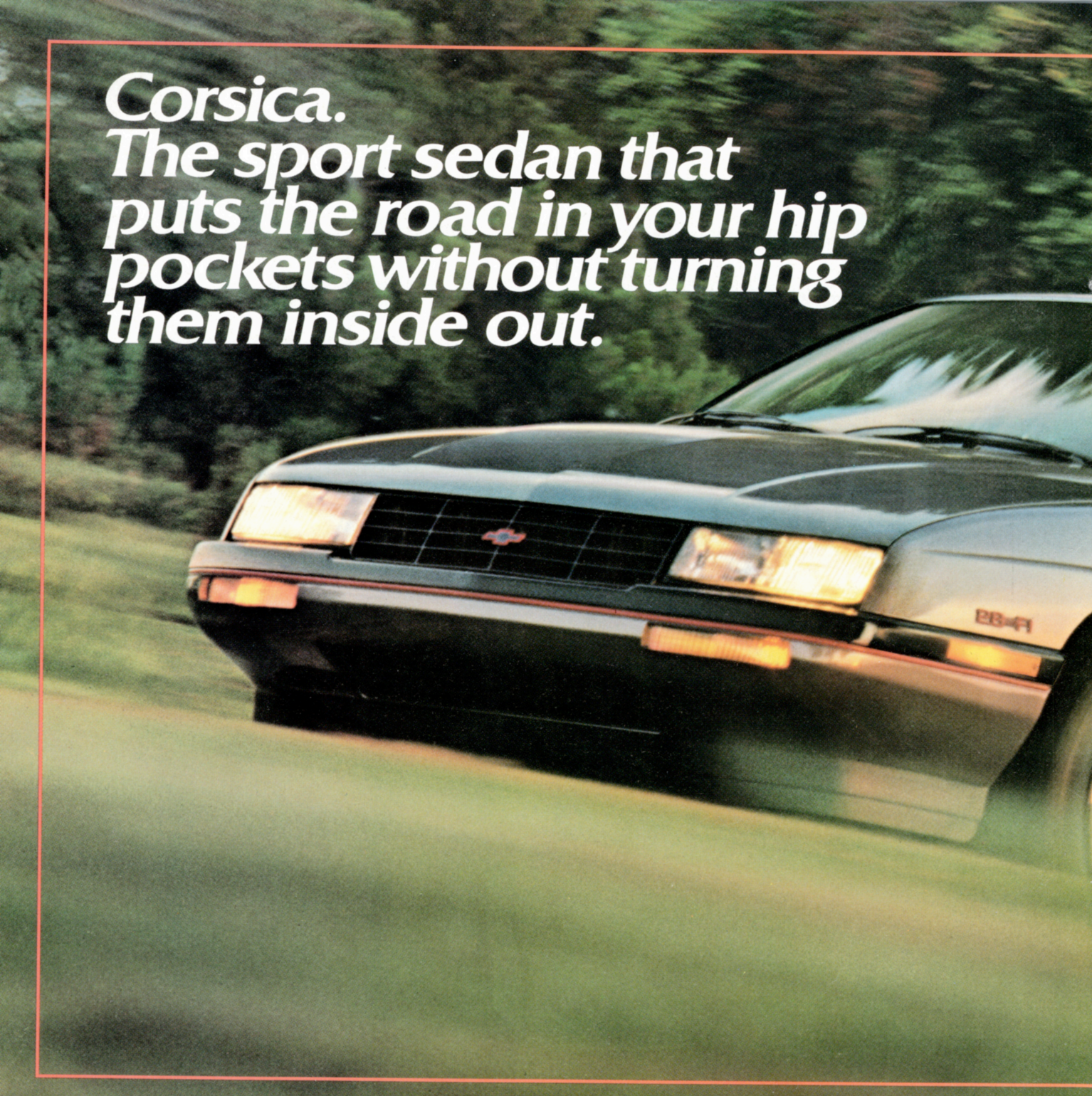

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TODAY'S CHEVROLET

When he tried to prove quantum mechanics isn't as odd as it seems, this unlikely guru ended up twisting reality another turn into the weird zone where particles light-years apart may communicate instantaneously

INTERVIEW

JOHN BELL

More than 25 years ago John Bell had a chance to tell off the great Danish physicist Niels Bohr, one of the founding fathers of quantum mechanics. "It was the inauguration of CERN," Bell recalls. "I went up in a hotel lift with him. I didn't have the nerve to say, 'I think your Copenhagen interpretation is lousy.' Besides, the lift ride wasn't very long. Now, if the lift had gotten stuck between floors, that would have made my day! In which way, I don't know." Bell roars.

Bell has a curious position in the pantheon of particle physicists. At CERN, the monstrous European physics laboratory outside Geneva where he works, his colleagues consider him a shrewd puzzle solver. He's a fellow who slowly but surely helps to advance the field by patiently unraveling the threads of tiny, concrete problems left after more speculative minds have forged recklessly ahead. But there is another set of people—nonscientists mostly—who look upon him as an intellectual saint for his work interpreting the meaning of quantum mechanics, the theory that describes the world of the atom. To them, he is something of a quantum guru.

Redheaded, red-bearded Bell has always been troubled by quantum mechanics. Born in Belfast, Northern Ireland, in 1928, he first encountered quantum theory while at the local technical college and found it strange indeed. Quantum mechanics seemed to say that the entities of the subatomic world—electrons, photons, and the like—cannot be pinpointed. They exist in a haze of random possibilities until "actualized" in particular circumstances, as when a scientist performs a concrete experiment on them. Does that mean that the properties of matter are, in effect, created by human beings? That was indeed a suggestion of Bohr's Copenhagen interpretation. It was vainly

PHOTOGRAPH BY PETER MENZEL

challenged by Einstein, who argued that future physicists would discover presently unknown factors. These "hidden variables" would eliminate the randomness and uncertainty of quantum mechanics and allow physicists to measure the behavior of subatomic particles as if they were billiard balls. Others argued that no such return to determinism (the old belief in certainty) was possible. At the lowest levels of matter, they said, things don't really exist until you look at them.

Bell graduated from college in 1949, began work as an accelerator physicist, and in 1960 wound up at CERN. Continuing to harbor reservations about the Copenhagen interpretation, he ultimately set out to refute it. To his surprise, his conclusions suggested that quantum mechanics is even stranger than anyone suspected. In two brilliant papers, the first published in 1965, he proved what is known as Bell's theorem. Roughly, Bell's theorem says that when two particles are emitted in opposite directions and the properties of one of them are "actualized" by being measured, the properties of the other will be found to be correlated, or linked, when it, too, is measured—no matter how far apart the particles are. It's as if there were some kind of instantaneous communication between them. Bell's theorem mathematically eliminated the possibility that a "hidden variable" could explain this connection. Somehow the particles are linked, even if there are light-years between them.

Bell's theorem has acquired near-religious status among certain popular authors who feel it proves the ability of subatomic particles to "think," the basic "wholeness" of the universe, faster-than-light communication, and a host of other mystical foofaraw—what the late great physicist Richard Feynman called "the cargo cults of science." Experiments proving Bell's theorem, wrote Michael Talbot recently in *Beyond the Quantum,* constitute "the final proof that reality as we know it does not exist at the subatomic level." Bell himself has been summoned to dine with the Dalai Lama and to address the students and faculty at Maharishi University. Strange company for a self-described "cold-blooded" physicist who likes nothing better than to talk about particle accelerators with his physicist wife, Mary.

We first asked Bell over the telephone whether he himself felt he had demonstrated that "reality doesn't exist." He responded by warning us that he is an impatient, irascible sort who tolerates no nonsense. He did, however, agree to speak with us, jotting down the appointment, we later learned, in his *Pocket Diary for Physicists,* which lists the birthdays of famous scientists. In the flesh, we found him to be a soft-spoken man who talked extremely patiently to us for several hours.

—Charles Mann and Robert Crease

Omni: From your student days, were you always interested in physics?

Bell: I was interested in philosophy first. But then I got frustrated with it because each generation of philosophers seemed to overturn the generation before. That was how I got into physics, because it was not so far from philosophy, and there was an accumulation of knowledge.

Omni: Hasn't each generation of physicists overturned the previous one?

Bell: No. I think it's true there are scientific revolutions—big changes at a few points. But it's very seldom that anything is scrapped. We still have Newton's equations, although Einstein's conception of space has replaced Newton's. We still have Maxwell's equations, although quantum field theory has replaced classical field theory. Things still fall the way Galileo said. It all builds up.

When I came to learn quantum mechanics, which I did very soon after I went to the university, I was dissatisfied with the expositions I found. This wave function—one never knew whether it was something real or some kind of bookkeeping operation.

"When we get down to things beyond our immediate experience, the concept of "out there" and "really there" and so on begins to lose its relevance."

Omni: What's a wave function?

Bell: If you do any careful experiment with electrons, there comes a point when you see that they are not behaving according to classical mechanics. The electrons seem to be influenced by some kind of wave, so they can show interference patterns. Not any one electron but many electrons arriving on a photographic plate build up an interference pattern. So somehow you have particles—because you see a series of little spots on your plate—and a wave, which directs them in some way. The relation between this wave and the particles has never really been clearly understood. One knows the mathematics of the wave, and one has the rules for translating the amplitude of the wave into a probability distribution for particles [a kind of mathematical "map" charting the places where a particle might land]; but physicists have not agreed on whether the wave is really there.

Omni: So quantum mechanics explains these particles in terms of waves, and nobody is sure if any of it is real in any ordinary sense. Well, *are* there real objects out there at all?

Bell: I believe there is something out there. But the philosophy that has grown up with quantum mechanics, the Copenhagen interpretation, calls that reality into question. It says we're not entitled to assume something is out there. Perhaps we are entitled to on the gross scale. I am entitled to assume that you're out there; but I am not entitled to assume that you are made of electrons that are out there. Somehow when we get down to these things beyond our immediate experience, the concept of being "out there" and "really there" and so on begins to lose its relevance.

Omni: Why don't we have an adequate mathematical description of these things?

Bell: To call it a description of things is already to imply the *things.* Ordinary quantum mechanics doesn't sort out the difference between "description" and "thing." It is only description. Einstein was always asking, "What are the things described?" Think of insurance actuarial tables—you'll find curves identifying the probable age of death of a person who is a given age now. But in order to make that meaningful, you need the concepts of people and death. If you had only the curve you'd ask, "What is it the probability *of*?" And the answer to this question is *missing* in ordinary quantum mechanics—until you come to the gross level, where it's the probability of the result of an experiment. So you can talk about experimental equipment in this way. But the electrons and so on—these you are not allowed to speak about. You . . . can't talk of them.

Omni: These waves are like literary characters that don't exist apart from the words that describe them but nonetheless have a certain reality for us.

Bell: That's a good analogy. And it's as if the book nevertheless had consequences at certain places. Here are these fictitious characters, but at some point the characters cease to be fictitious.

Omni: What is the Copenhagen interpretation? Can you describe it?

Bell: *The Copenhagen interpretation* is a very ambiguous term. Some people use it just to mean the sort of practical quantum mechanics that you can do—like you can ride a bicycle without really knowing what you're doing. It's the rules for using quantum mechanics and the experience that we have in using it. There are big things like laboratory instruments, and there are little things like electrons. The big things we can treat classically; but the little things like electrons have dynamics governed by waves. And there is such a difference in scale between the little ones and the big ones that it doesn't matter much where you draw the boundary. The rules of pragmatic quantum mechanics, which are absolutely marvelous, work extremely well. And you could say these also came from Copenhagen, at least in part. Niels Bohr, the genius of Copenhagen, was one of the key people who clarified these rules.

Then there's another side to the Copenhagen interpretation, which is a philoso-

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phy of the whole thing. It tries to be very deep and tell you that these ambiguities, which you worry about, are somehow irreducible. It says the ambiguities are in the nature of things. We, the observers, are also part of nature. It's impossible for us to have any sharp conception of what is going on, because we, the observers, are involved. And so there is this philosophy, which was designed to reconcile people to the muddle: You shouldn't strive for clarity—that's naive. "Muddle is sophisticated." I have heard distinguished people say that this philosophy was important to them as physicists. It allowed them to feel somehow that these things were understood and that nothing could be done except what they were doing. Then they got on with their work. Einstein called it the "tranquilizing philosophy" from Copenhagen "on which the true believer can find a soft pillow on which to rest his head. Let him lie there!"

Omni: As a student, you weren't reassured by the Copenhagen interpretation.

Bell: When I found the professors repeating what I saw written in the textbooks, I got angry and said it was nonsense. My professors were actually very tolerant, because I pestered them a great deal. But from time to time I could see that they were at the end of their patience.

Omni: Part of the problem is that there's a quantum world where this strange wavy stuff happens, and you have an ordinary world where ordinary, unwavy stuff happens—and you don't know where to draw the line between them. Is it like knowing that there are the colors blue and green but not knowing at what point blue stops and green starts?

Bell: The present situation is that we have a set of equations for blue and another for green. At the boundary you can pretend it's either blue or green to a very good approximation, and it doesn't make much difference. The world where we are obliged to use quantum mechanics is very, very remote from us. And somewhere between here and there is this change in language. So far in practice it doesn't matter where we change the language, roughly speaking, from particles to waves. And that's why you can get along in practice without deciding it. But it's still a problem theoretically, such a puzzle. You work as if there were two separate worlds: a blue world and a green world, blue equations and green equations. It *can't* be right.

Omni: When you went to the university, quantum mechanics was less than twenty years old. Newtonian mechanics, which said everything in the universe was definite and predictable, was replaced by quantum mechanics, which said on the subatomic level many things were random, and the laws could only be statistical. Were physicists still dismayed?

Bell: When quantum mechanics was invented, everybody must have asked, "Can we imagine a more complete theory in which the predictions would not be of a statistical character?" Einstein and [Nobel laureate] Louis de Broglie were certainly among the first to press this question. But the orthodox line quickly became, No, there is no possibility of finding a more complete description than that given by quantum theory. Nature is inherently statistical, so the statistical aspect of quantum mechanics is not provisional or temporary.

Then in 1932 [mathematician] John von Neumann gave a "rigorous" mathematical proof stating that you couldn't find a nonstatistical theory that would give the same predictions as quantum mechanics. That Von Neumann proof in itself is one that must someday be the subject of a Ph.D. thesis for a history student. Its reception was quite remarkable. The literature is full of respectful references to "the brilliant proof of Von Neumann;" but I do not believe it could have been read at that time by more than two or three people.

Omni: Why is that?

Bell: The physicists didn't want to be bothered with the idea that maybe quantum theory is only provisional. A horn of plenty had been spilled before them, and every physicist could find something to apply quantum mechanics to. They were pleased to think that this great mathematician had shown it was so. Yet the Von Neumann proof, if you actually come to grips with it, falls apart in your hands! There is *nothing* to it. It's not just flawed, it's *silly*. If you look at the assumptions made, it does not hold up for a moment. It's the work of a mathematician, and he makes assumptions that have a mathematical symmetry to them. When you translate them into terms of physical disposition, they're nonsense. You may quote me on that: The proof of Von Neumann is not merely false but *foolish*!

Omni: Didn't Einstein point out the deficiency in the orthodox view?

Bell: Einstein was convinced that something must lie behind the statistical quantum mechanics that would not be statistical in origin. In 1935 Einstein, Boris Podolsky, and Nathan Rosen then produced their famous argument, which was an extremely powerful one. It said that because quantum correlations exist between distant objects, and in certain circumstances *perfect* correlations between such objects, you *could not* believe that there was independent chance in what the objects were doing.

Omni: We don't get it. Suppose we take a coin and slice it in half along the edge. We seal each half in different envelopes. We take one, you take the other, and we travel to opposite sides of the earth. We open our envelope, and it's heads. We know yours is tails. What's so strange about that?

Bell: There is no mystery because the head and the tail were there *all along* from the beginning. But suppose you didn't believe each bit was either heads or tails until the moment you looked at it. And then it just chose at whim, at hazard, by chance, to be heads or tails. How could you believe

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that the other one would coordinate its response? The head and the tail that are "there before you look" are simply *not included* in the quantum description. It tells you about the *results* of your observations; beforehand, there is just a wave function, which has neither head nor tail. And Einstein objected to that. He said to make sense of this situation we must believe that the head and the tail are there from the beginning and are just revealed when we look. So he took, like you, a commonsense attitude to this. You see, Einstein took the view that quantum mechanics is incomplete. It doesn't tell you the whole story. And for me, Einstein's was a compelling argument.

Again, part of that psychohistorical study I would like to see is why it did not impress the Copenhagen people, especially Bohr. But in the end it turns out that these other people were, in a way, right, because what I am notorious for, the so-called Bell's theorem, is just for showing that Einstein's explanation doesn't work. Einstein's explanation works so long as you have perfect correlations, which means measuring the same component of spin on the two sides [spin is a measure of a property similar but not identical to the rotation of a particle on its axis]. But as soon as you are measuring in a nonparallel direction, you get results that cannot be explained by Einstein's idea that the answers existed before the experiment.

Omni: Didn't anybody react to Einstein, Podolsky, and Rosen?

Bell: In 1952 David Bohm gave a fully worked out hidden-variable account of quantum mechanics in which everything was deterministic and definite. The kind of ignorance was of the trivial kind: *Nature knows, but I don't know.* That was a big thing for me. It told me that Von Neumann was wrong, because Bohm had done what Von Neumann had shown to be impossible. Bohm's paper wasn't rigorous. It didn't have big displays of axioms, theorems, or lemmas [corollaries]. But one could see immediately that what he was saying was right. My reservation about his work and that of others in the physics community was that it was nonlocal, that what you do here [he points] has immediate consequences in remote places [pointing out window]. And that was *extremely* odd.

Omni: What does *locality* mean?

Bell: It's the idea that what you do has consequences only nearby, and that any consequences at a distant place will be weaker and will arrive there only after the time permitted by the velocity of light. Locality is the idea that consequences propagate continuously, that they don't leap over distances. And so the question immediately posed itself: Is that inevitable? Can you find another way of refuting Von Neumann that does not have this feature of nonlocality?

Omni: Bohm's paper was written when you were a recent graduate. Yet despite your doubts about the Copenhagen interpretation, you didn't write anything on it until twelve years later. Had the problem just dropped out of your mind?

Bell: It was never completely out of my mind. I always knew that it was waiting for me. So when I went to the Stanford Linear Accelerator Center at the end of 1963, arriving in California the day after President Kennedy's assassination—it was a very odd experience to find everybody crushed. The quantum problems were very much in my mind. And that's where I wrote the papers that subsequently became notorious. First of all, I wrote a paper refuting all the proofs known to me of impossibility theorems for hidden variables. While doing that, I saw that this problem of locality was vital. So that paper ended with this question: If you make locality a condition, can you then make a good proof of the impossibility of hidden variables?

The second paper answered that question. I tried to imagine what hidden variables there might be that would avoid the nonlocality of Bohm and nevertheless account for the quantum correlation. And I found that I couldn't do it. Something always went wrong. And then I began to suspect maybe it was impossible.

"The theorem says that maybe there must be something faster than light, although it pains me to say so. It implies that Einstein's concept of space and time isn't tenable."

Omni: So is this the price that not only Bohm but everybody has to pay?

Bell: That's right. Then when I suspected the impossibility and I made a phase transition in my mind, I started looking for the proof of impossibility. And I found it.

Omni: What you expected when you started wading into this more than twenty years ago and what actually came out were very different things.

Bell: That's true. Yet I'm not so sure what I felt then. I certainly was indignant with the expositions that I saw and with arguments that I saw. I felt a great desire to knock them down. Whether I expected to come out with an Einsteinian interpretation of quantum mechanics is not clear to me. What I succeeded in doing was showing that such an interpretation as I sought was not possible. It wasn't possible even for the arguments that I now regard as good arguments [chuckles], as distinct from the bad arguments like Von Neumann's that I had seen before. What I really wanted was a clear argument, rather than to justify any particular conception of the world. From what I know of my own character, which is somewhat stubborn, I am often more concerned with the conduct of the debate and its logic than with the actual truth.

Omni: But don't you think logical debate is the way to truth?

Bell: You need both sorts of people in the world—people who don't care about the logic but only about the truth and who intuit what it is, and people who are concerned about the logic. The great physicists combine the two concerns; but most of us are lucky to contribute on one side. The whole activity is cooperative in the end.

Omni: What did this second paper, the one containing Bell's theorem, tell us?

Bell: The theorem tells you that maybe there must be something happening faster than light, although it pains me even to say that much. The theorem certainly implies that Einstein's concept of space and time, neatly divided up into separate regions by light velocity, is not tenable. But then, to say that there's something going faster than light is to say more than I know. If anything goes faster than light, then I could imagine that if you were tossing a coin, I might be able to make it do an extra turn [without, so to speak, touching it]. But you would never know I had that power, because you wouldn't know whether it was coming down heads or tails, anyway. And *I* wouldn't know that I had that power.

Omni: Because you'd see only the final result, which would be heads or tails, you couldn't see what it would have been had you not exercised that power.

Bell: Exactly! And it's only in the analysis of this question of "what would have been" that the theorem obliges you to introduce such funny connections. The calculations that we do in quantum mechanics make certain predictions for whether the detectors in an experiment both say yes or both no, or disagree. And it's those predictions that are incompatible with *any* mechanism that does not go faster than light.

Omni: How were these papers received?

Bell: There was not great reaction at first. I suppose that anybody who read it just thought, *Well, that's an interesting puzzle.* And then in 1969 people proved a more practical form of the result and proposed an experiment. Then people started doing the experiments. The results confirmed ordinary quantum mechanics and therefore disconfirmed Einstein's hopes. Then there was more and more publicity.

Omni: What importance does all of this have for physicists?

Bell: It's a hard question, even an embarrassing question. Quite a lot of physicists are content with the fact that quantum mechanics is something that works, yet which is by no means worked out. All the developments we see around here are based on that, and it's doing just fine. So my theorem is a marginal sort of thing.

Omni: Is there some big problem hidden in these quantum muddles?

Bell: Yes. For me the big question is the

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role of Lorentz invariance, which in some obscure way tells you that something cannot go faster than light. During the nineteenth century people became convinced that light, like sound, was a wave motion. Just as sound waves move in air, light has to move in a medium, which had come to be called the ether. Now, as you move through the air, the velocity of sound relative to you changes. It will come more quickly toward you from a distant source as you move toward the source and so on. The trouble was that with light this was found not to be the case.

If you think of the earth as moving around the sun, then it's moving in different directions at different times and at different velocities. So if you measure the velocity of light passing through your laboratory, sometimes the ether should be running against your motion and other times with your motion, and you should see different velocities of light relative to your laboratory position. Well, people didn't. They found that the velocity always seemed the same relative to the laboratory. To explain that, Irish physicist George FitzGerald invented the idea that moving bodies actually contract. Next Irish physicist Joseph Larmor invented the idea that moving clocks go slower. He said that when you *think* you're measuring the velocity of light, you're fooled by your clocks having changed their rates. These things happen in just such a way as to make you *think* light is still moving with the usual velocity.

Then Einstein came along and questioned this "conspiracy" to make things unobservable. If this "unobservability" [of light] is systematic, it must be really an expression of some deep truth, he said. And the deep truth is that all laws of nature are such that you cannot detect uniform motion in any laboratory. That idea has come to be called Lorentz invariance, because [the great Dutch physicist] Hendrik Lorentz was one of Einstein's predecessors in working out this idea. And that imposes certain restrictions on the equations of theoretical physics.

This principle of Lorentz invariance was speculative when Lorentz formulated it around about 1900. But now it has been so solidly built into physical theory that it is extremely difficult to consider giving it up. The idea that somehow nature has no preferred velocity and no preferred inertial reference system [such as ether] has paid off enormously. But this idea presents one of the biggest difficulties in formulating quantum mechanics in a sensible way, because when you look at these funny paradoxes of Einstein, Podolsky, and Rosen, they seem to imply that something goes faster than light. But Lorentz invariance is very embarrassed by anything going faster than the speed of light, because that would seem to say that you should be able to measure the simultaneity of distant events more precisely than you can using light. Yet somehow the fact that light is the quickest measurement available is built into the theory of relativity. Now, it's not as simple as that; and that's just the kind of thing I would like to investigate. What restrictions on velocities—and velocities of what—are really imposed by Lorentz invariance?

Omni: People have found in this connection between distant events a sort of scientific affirmation of Zen Buddhist thought in which every part of the universe is related to every other within the whole.

Bell: The idea that there is a relation to Eastern mysticism comes already from Bohr and maybe before. Bohr's coat of arms, which he chose himself, has the yin–yang symbol embodied in it. He thought that the ambiguities we face in physics are related to the ambiguities that Eastern mystics have faced—the union of the observer and the universe and so on. That theme was taken up in particular by Fritjof Capra. His book *The Tao of Physics* has sold many copies, but I have no responsibility for that. I got into the picture, and people found I had deepened the mystery.

"The Dalai Lama said that if physics was committed to a once-only universe, then "the Buddhists would have to study their scriptures. There's room for maneuver."

I think that's true, because my result destroyed the possibility that the world could be Einsteinian. But it must be something more complicated than that: There is some kind of hidden connection.

So the ecological people, Green people, people who feel that ordinary science is cold and materialistic and hostile—they liked my result. It brought back a warm togetherness. I have some sympathy with that. I cannot write like that because I don't see it like that. But still, I'm usually on the same side as those people in other things, like conservation and soft science and whole-meal bread and all those things. I even feel quite warm toward those people.

Omni: But you don't see it that way.

Bell: No, because I don't have that mystical insight. I am essentially an agnostic about religious and spiritual matters. When people give answers to these questions, I think it's wishful thinking. I don't feel hostile toward these people, but I just don't share their enthusiasm at finding answers to questions that seem to me unanswerable. I admit that there are questions that science cannot answer—that science cannot even ask. But I myself don't have answers to these questions. When I hear people saying we've finally answered it, and the answer is Buddhism or Taoism or something else, I just have to say that when I look at those things I don't find the answer. Even so, if other people find the answers there, I'm not going to campaign against them. That's their business. They are doing no great harm. There are ideologies that are much more vicious than Buddhism.

Omni: This movement to link physics and mysticism—do you think it's bad?

Bell: I don't think it's evil, but I don't think it's right. In my opinion physics has not progressed far enough to link up with psychology or theology or sociology. What we deal with in physics are the very *simplest* questions. We simplify situations to the limit in the hope of finding that the laws of simple things can be built up into the laws of complicated things. The kinds of problems we address ourselves to in physics are just too remote from anything of spiritual concern to be relevant. I don't think Bell's theorem moves you nearer to God.

Omni: Are people simply picking up the poetic resonances of these ideas?

Bell: Yes! Now, poetry—that's the correct way to see it. Poetry isn't addressed to solving the problems of physics. It is addressed to touching human emotions. If it has a message, it's not on the intellectual level. So as poetry, I can appreciate Capra and others. But as physics, I don't appreciate them at all. Now, the test for a physicist of whether those people have something to contribute would be to ask them not to interpret what we have done already but to tell us what is going to happen next. If they can tell us the mass of the Higgs boson [a theoretical new particle], and if we find it, there, we are all going to learn their philosophies. [Laughs] We'll all go and sit at the feet of Maharishi if he tells us where the Higgs boson is to be found.

I have the feeling that these things do not come from genuine mystics but from amateur mystics, people who find this romantic possibility opening and see some parallel with physics. People who have devoted their lives to mysticism are not doing this. They make the judgment that they don't know enough about physics. Physics is technical. You can't learn it too well by reading popular books. But my feeling is that those guys feel they are onto something much bigger than physics. They are not going to worry about whether there are three quarks or six.

Omni: Why is it that mystic physics books sell so well?

Bell: People are looking for comfort; and if somebody offers it to them, they try hard to believe it. These ideas really mean that we live in a less hostile world, with the possibility of coupling to the heart of things. It's comforting to think that not only are priests and mystics saying this, but now we have the physicists with their machines verifying it. The idea that people are back in the middle is very comforting, so it's easy to seize upon. You'd have to be a masoch-

CONTINUED ON PAGE 121

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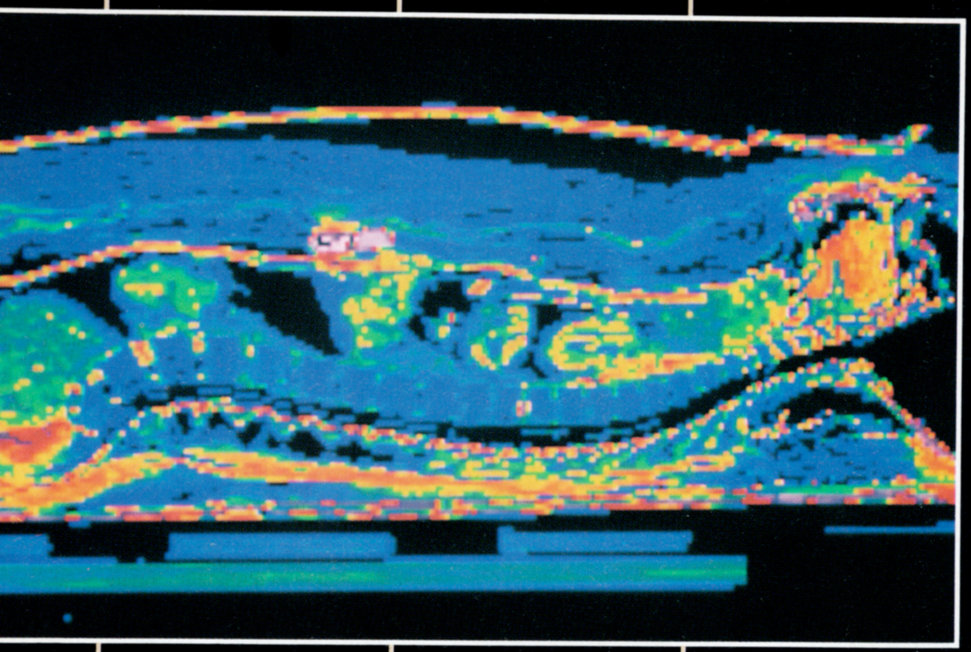
BOUND FOR GLORY

BY NINA GUCCIONE

AT FAR LEFT IS THE CARTONNAGE OF NESPANETERENPERA, A THEBAN PRIEST (EGYPT, CIRCA 1000 B.C.). CARTONNAGE WAS CONSTRUCTED TO BEAUTIFY THE MUMMY. NEAR LEFT: X RAY TAKEN OF A MUMMY'S SKULL.

It's no easy task to woo your spirit back after death, so you'd better make sure you look your best. Resurrection and immortality were central to the Egyptians' religious beliefs. But to ensure that the body would rise again, all the pertinent elements present during life had to accompany the body in death—organs, name, and spirit. The elaborate funerary customs were restricted to the society's elite, wealthy, or royal.



In the past, mummies had to be examined by unwrapping the yards of encasing linens. Once unraveled, it was impossible to put the mummy back together.

Medical technology finally caught up with a 3,000-year-old mummy—Ta-bes, an Egyptian singer. At the Museum of Fine Arts in Boston, restorers cleaned and prepared Ta-bes before transporting her to the hospital where she would undergo X rays in a CT (computed tomography) scanner. Unlike conventional X rays, a CT scan can produce images of soft tissue, which is left by embalming.

TOP: PREPARING FOR TA-BES'S HOSPITAL VISIT. FAR LEFT: X RAY OF TA-BES'S SPINE. NEAR LEFT: HER RESIN-THICK HAIR AND NOTCHED NOSE. RIGHT: AN X RAY OF HER TORSO. BELOW: PHOTO OF AN EGYPTIAN MUMMY CIRCA 1850 B.C.

The preserving process took about 70 days. The body was slit and the internal organs removed, except for the heart. The viscera were then cleaned and put back into the body. The heart, believed to be the source of all life and thought, had an amulet placed over it to protect it from ever testifying against itself. The brain was pulled out by a hook through the nose and discarded. Ta-bes was prepared in this way and still had a few amulets left inside to ward off evil. X rays revealed a bad back and a small head tumor but not the cause of her death.

SPACE

CONTINUED FROM PAGE 24

Even artists are affected by what's happening in space, "not only in terms of subject matter but in terms of all kinds of new materials that can be used," Galloway says. And designer Mary Edwards is living proof of Galloway's theory. Edwards actually grew up with the space program: Her father, an electrical engineer, was part of the team that sent the first monkey into orbit. But she was drawn to the visual arts, not the sciences. After studying art all over the world, she eventually became a textile designer and is now president of a rug- and tapestry-design firm bearing her name in San Francisco.

In 1985 Edwards happened to attend a lecture given by Yvonne Clearwater, who had begun her career advising former California governor Jerry Brown on how to build institutional office buildings that wouldn't corrode the human spirit with their sterility. She later became a specialist on the psychological effects confinement could have on humans isolated in such places as submarines, offshore oil rigs, and remote regions like Antarctica.

In 1984 Clearwater joined the newly created Space Human Factors Office at the NASA/Ames Research Center. Looking for assistants who shared her belief in humanistic design, she chose Edwards to join a collaborative color team composed of psychologists, physiologists, and engineers to brainstorm ideas about the effects of different colors, fabric textures, and lighting on people confined to a spacecraft for months or years on end.

Their research has involved large doses of scientific testing—such as measuring people's nervous-system reactions to different environments—and a dollop of intuition. Because space station passengers will be both private citizens and astronauts, Edwards reasons, "We're potential users; what would we want?"

The answers are in a mock-up module in a laboratory near Clearwater's NASA office. Each passenger's private space is the size of a large telephone booth. The interior walls are dark on the bottom and light at the top—like the earth and the sky. There is a console for playing tapes and videos, a phone to speak to loved ones on Earth, a bulletin board for photographs, and a long mirror so people can remember what they look like.

Some of the team's findings about onboard art are being tested by scientists stationed in Antarctica. Clearwater and her ten investigators asked research subjects to choose among hundreds of photographs in nine categories, from animals to automobiles. The overwhelming favorite was landscapes "with water, without buildings, with foreground detail. They had a physiologically calming effect on the viewers," Clearwater says.

In the public areas of the space station Clearwater and Edwards would like to see an international art gallery. "There are fairly boring tunnels that go from one module to another," says Edwards. She would like to see posters of things like the running of the bulls in Pamplona, Spain, colorful tulips blooming in Holland, and San Francisco's Golden Gate Bridge.

Because there's no gravity in space, space station passengers will have to sleep vertically. Edwards and Clearwater have designed a plush, glittery sleeping bag, with an ocean-blue outside and a rainbow-hued interior. "The bottom line," says Clearwater, "is that we think the farther we send people from everything that's familiar to them, the more responsibility we have, not for replicating those surroundings but for giving them links. Artwork, communications with home, choices—all those Earth ways enhance people's humanness, rather than depriving them of it in this machine-dominated setting."

When the hardware for the space station laboratory is constructed by the Boeing Aerospace Corporation, one of the systems engineers will be twenty-eight-year-old Marla Baer-Peckham. Her job at Boeing's Huntsville, Alabama, headquarters involves "figuring out how the pieces work as part of the whole," such as evaluating power requirements of particular payloads or whether the space station needs certain types of microscopes or blood-sampling equipment as part of its onboard hardware.

"In the past there's been this he-man, we-can-live-in-anything attitude. Women tend to care more about quality-of-life issues that could come up in space, like relaxation and art."

Baer-Peckham agrees with Clearwater that "typical" female attitudes can be a plus in designing a habitat. "In the past there's been a lot of the he-man, we-can-live-in-anything attitude, as if it's perfectly normal to live without a shower for two months," she notes. "Women tend to care more about the quality-of-life issues that could come up in space, like relaxation, communication with our families, and art."

Baer-Peckham's husband, David, also works on Boeing's space station project, although in a different unit. "Sometimes it's stressful waving at each other across airports," she says.

It seems one of the more difficult places for women to succeed is within the large private-sector aerospace companies. Clearwater, who worked in private industry before coming to NASA, remembers being criticized by a superior for "enjoying my work too much." "There's a glass ceiling in there for women. You can stand under it and look up through it at the guys at the top, but you can't get past it," she says.

Dee Ann Divis, head of marketing and Washington operations for a small company that hopes to build a private space minishuttle, adds, "In the big companies the hierarchy is set. Most of the guys are older, and they're not used to perceiving women in the role of equals."

Divis's Nevada-based company, Third Millennium, Inc., wants to have its Space Van ready for service in 1993. Lighter and less than half the length of the conventional shuttle, the reusable shuttle will ideally cut costs and the time businesses have to wait to send payloads into space.

But most of these visions, from a new, long-range civilian space program to the establishment of bases on Mars and the moon, are still just a wish list. Many women, like their male colleagues, are wondering what lies ahead for the American space program in these economically shaky, post-*Challenger* times.

"It's make-or-break time," says Brenda Forman. "The gap the Soviets opened up is widening by the day. And while the Japanese are currently behind the Europeans, if you look at the curve of Japanese space spending, it's climbing precipitously."

Although the recent go-ahead given to the long-delayed Jupiter mission is good news, plenty of careers have been run off course by American space priorities—or the lack of them. And whether women can transform the space industry or whether they will simply fit into the old boy network is unclear. Indeed, some women worry that the only way they can get ahead and stay ahead is to adopt stereotypically male priorities. Like women in law, medicine, and the business world, they are finding that the demands of a male-dominated, workaholic industry may not be compatible with the pull of motherhood.

Forman says she cannot see both having a child and continuing a career in the space industry. "I think child rearing is one of the hardest jobs there is, and I couldn't bring myself to make that sacrifice. I'm just grateful that I belong to the first generation of women who could really make the choice not to have children."

"The good news," says Marcia Smith, "is that we [American women] are doing a lot better than anyone else. When I was in Brighton, England [for the 1987 conference of the International Astronautical Federation], meeting with the Brits and the Japanese and the Soviets, I was back to being the only woman in the room. I used to be much more critical of the way Americans treat women, but in this country it's been a while since I've been the only woman in the room."

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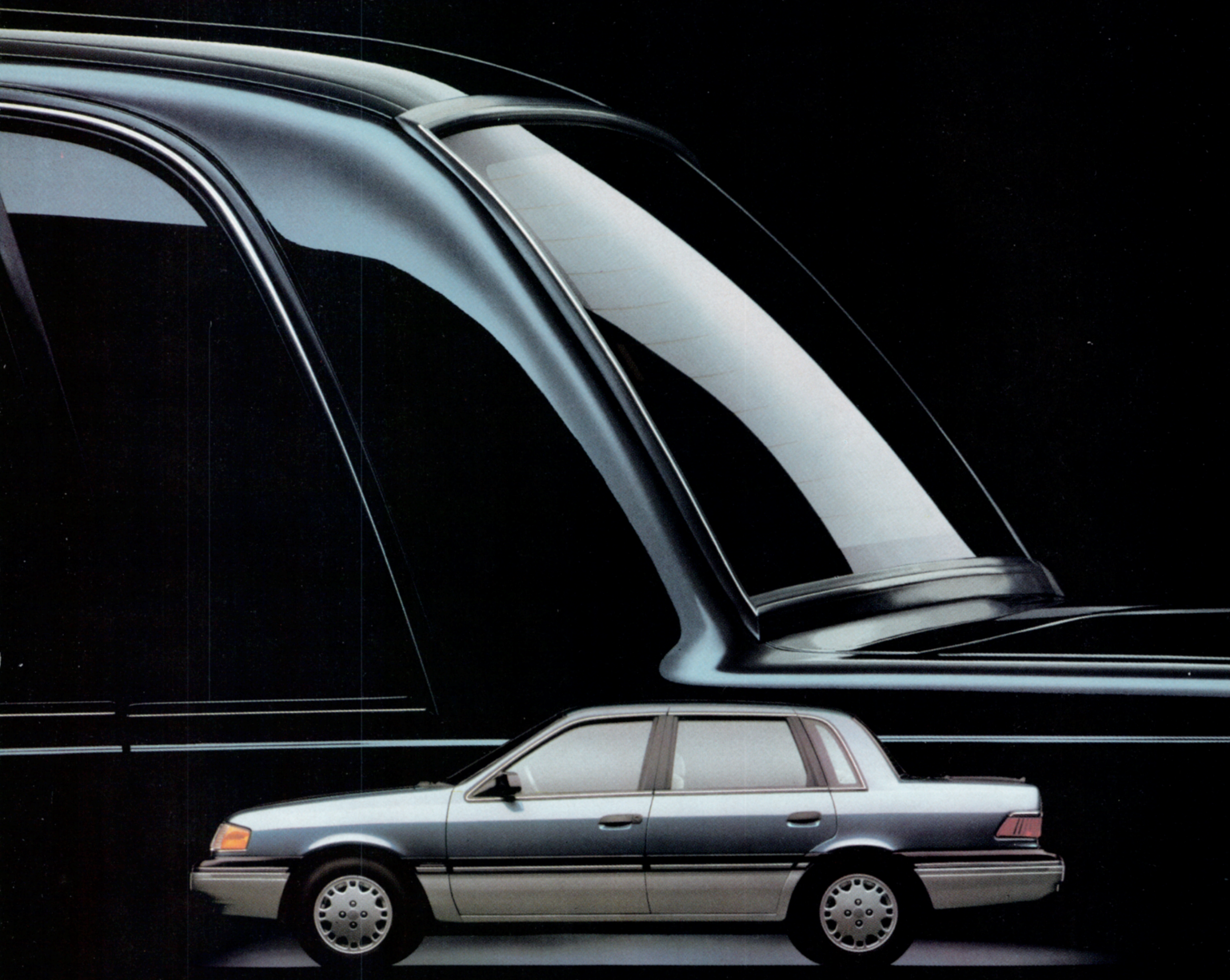

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FICTION

THE GIRL WHO LOVED ANIMALS

BY BRUCE McALLISTER

If only you had the power to save an endangered species, how far would you go?

They had her on the seventeenth floor in their new hi-security unit on Figueroa and weren't going to let me up. Captain Mendoza, the one who thinks I'm the ugliest woman he's ever laid eyes on and somehow manages to take it personally, was up there with her, and no one else was allowed. Or so this young lieutenant with a fresh academy tattoo on his left thumb tries to tell me. I get up real close so the kid can hear me over the screaming media crowd in the lobby and see this infamous face of mine, and I tell him I don't think Chief Stracher will like getting a call at 0200 hours just because some desk cadet can't tell a privileged soc worker from a media rep, and how good friends really shouldn't bother each other at that time of the day anyway, am I right? It's a lie, sure, but he looks worried, and I remember why I haven't had anything done about the face I was born with. He gives me two escorts—a sleek young swatter with an infrared Ruger, and a lady in fatigues who's almost as tall as

PAINTING BY ARMODIO

I am—and up we go. They're efficient kids. They frisk me in the elevator.

Mendoza wasn't with her. Two P.D. medics with side arms were. The girl was sitting on a sensor cot in the middle of their new glass observation room—closed-air, antiballistic Plexi, and the rest—and was a mess. The video footage, which four million people had seen at ten, hadn't been pixeled at all.

Their hi-sec floor cost them thirty-three million dollars, I told myself, took them three years of legislation to get, and had everything you'd ever want to keep your witness or assassin or jihad dignitary alive—CCTV, microwave eyes, pressure mats, blast doors, laser blinds, eight different kinds of gas, and, of course, Vulcan minicannons from the helipad three floors up.

I knew that Mendoza would have preferred someone more exciting than a twenty-year-old girl with a V Rating of nine point six and something strange growing inside her, but he was going to have to settle for this christening.

I asked the medics to let me in. They told me to talk into their wall grid so the new computer could hear me. The computer said something like "Yeah, she's okay," and they opened the door and frisked me again.

I asked them to leave, citing Welfare & Institutions Statute Thirty-eight. They wouldn't, citing hi-sec orders under Penal Code Seven-A. I told them to go find Mendoza and tell him I wanted privacy for the official interview.

Very nicely they said that neither of them could leave and that if I kept asking I could be held for obstruction, despite the same statute's cooperation clause. That sounded right to me. I smiled and got to work.

Her name was Lissy Tomer. She was twenty-one, not twenty. According to Records, she'd been born in the East Valley, been abused as a child by both sets of parents, and, as the old story goes, hooked up with a man who would oblige her the same way. What had kept County out of her life, I knew, was the fact that early on, someone in W&I had set her up with an easy spousal-abuse complaint and felony restraining-order option that needed only a phone call to trigger. But she'd never exercised it, though the older bruises said she should have.

She was pale and underweight and wouldn't have looked very good even without the contusions, the bloody nose and lip, the belly, and the shivering. The bloody clothes didn't help either. Neither did the wires and contact gel they had all over her for their beautiful new cot.

But there was a fragility to her—princess-in-the-fairy-tale kind—that almost made her pretty.

She flinched when I said hello, just as if I'd hit her. I wondered which had been worse—the beating or the media. He'd done it in a park and had been screaming at her when Mendoza's finest arrived, and two uniforms had picked up a couple of C's by calling it in to the networks.

She was going to get hit with a beautiful posttraumatic stress disorder sometime down the road even if things didn't get worse for her—which they would. The press wanted her badly. She was bloody, showing, and *very* visual.

"Has the fetus been checked?" I asked the side arms. If they were going to listen, they could help.

The shorter one said yes, a portable sonogram from County, and the baby looked okay.

I turned back to the girl. She was looking up at me from the cot, looking hopeful, and I couldn't for the life of me imagine what she thought I could do for her.

"I'm your new V.R. advocate, Lissy."

She nodded, keeping her hands in her lap like a good girl.

"I'm going to ask you some questions, if that's all right. The more I know, the more help I can be, Lissy. But you know that, don't you." I grinned.

"I should have gone to the hotel, but the apartment was closer. I didn't look at the bedroom door, which is locked from the outside. Some days it's easier not to think about what's in there."

She nodded again and smiled, but the lip hurt.

I identified myself, badge and department and appellation, then read her her rights under Protective Services provisions, as amended—what we in the trade call the Nhat Hanh Act. What you get and what you don't.

"First question, Lissy: Why'd you do it?" I asked it as gently as I could, flicking the hand recorder on. It was the law.

I wondered if she knew what a law was.

Her I.Q. was eighty-four, congenital, and she was a Collins psychotype, class three dependent. She'd had six years of school and had once worked for five months for a custodial service in Monterey Park. Her Vulnerability Rating, all factors factored, was a whopping nine point six. It was the rating that had gotten her a felony restraint complaint option on the marital bond, and County had assumed that was enough to protect her . . . from him.

As far as the provisions on low-I.Q. cases went, the husband had been fixed, she had a second-degree dependency on him, and an abortion in event of rape by another was standard. As far as County was concerned, she was protected, and society had exercised proper conscience. I really couldn't blame her last V.R. advocate. I'd have assumed the same.

And missed one thing.

"I like animals a lot," she said, and it made her smile. In the middle of a glass room, two armed medics beside her, the media screaming downstairs to get at her, her husband somewhere wishing he'd killed her, it was the one thing that could make her smile.

She told me about a kitten she'd once had at the housing project on Crenshaw. She'd named it Lissy and had kept it alive "all by herself." It was her job, she said, like her mother and fathers had jobs. Her second stepfather—or was it her mother's brother? I couldn't tell, and it didn't matter—had taken it away one day, but she'd had it for a month or two.

When she started living with the man who'd eventually beat her up in a park for the ten o'clock news, he let her have a little dog. He would have killed it out of jealousy in the end, but it died because she didn't know about shots. He wouldn't have paid for them anyway, and she seemed to know that. He hadn't been like that when they first met. It sounded like neurotransmitter blocks, MPHG metabolism. The new bromaine that was on the streets would do it; all the fentanyl analogs would, too. There were a dozen substances on the street that would. You saw it all the time.

She told me how she'd slept with the kitten and the little dog and, when she didn't have them anymore, with the two or three toys she'd had so long that most of their fur was worn off. How she could smell the kitten for months in her room just as if it were still there. How the dog had died in the shower. How her husband had gotten mad, hit her, and taken the thing away. But you could tell she was glad when the body wasn't there in the shower anymore.

"This man was watching me in the park," she said. "He always watched me."

"Why were you in the park, Lissy?"

She looked at me out of the corner of her eye and gave me a smile, the conspiratorial kind. "There's more than one squirrel in those trees. Maybe a whole family. I like to watch them."

I was surprised there were any animals at all in the park. You don't see them anymore, except for the domesticates.

"Did you talk to this man?"

She seemed to know what I was asking. She said, "I wasn't scared of him. He smiled a lot." She laughed at something, and we all jumped. "I knew he wanted to talk to me, so I pretended there was a squirrel over by him, and I fed it. He said, Did I like animals and how I could make a lot of money and help the animals of the world."

It wasn't important. A dollar. A thousand. But I had to ask.

"How much money did he tell you?"

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"Nine thousand dollars. That's how much I'm going to get, and I'll be able to see it when it's born, and visit it."

She told me how they entered her, how they did it gently while she watched, the instrument clean and bright.

The fertilized egg would affix to the wall of her uterus, they'd told her, and together they would make a placenta. What the fetus needed nutritionally would pass through the placental barrier, and her body wouldn't reject it.

Her eyes looked worried now. She was remembering things—a beating, men in uniforms with guns, a man with a microphone pushed against her belly. *Had her husband hit her there? If so, how many times?* I wondered.

"Will the baby be okay?" she asked, and I realized I'd never seen eyes so colorless, a face so trusting.

"That's what the doctors say," I said, looking up at the side arms, putting it on them.

Nine thousand. More than a man like her husband would ever see stacked in his life, but he'd beaten her anyway, furious that she could get it in her own way when he'd failed again and again, furious that she'd managed to get it with the one thing he thought he owned—her body.

Paranoid somatopaths are that way.

I ought to know. I married one.

I'm thinking of the mess we've made of it, Lissy. I'm thinking of the three hundred thousand grown children of the walking wounded of an old war in Asia who walk the same way.

I'm thinking of the four hundred thousand walljackers, our living dead. I'm thinking of the zoos, the ones we don't have anymore, and what they must have been like, what little girls like Lissy Tomer must have done there on summer days.

I'm thinking of a father who went to war, came back, but was never the same again, of a mother who somehow carried us all, of how cars and smog and cement can make a childhood and leave you thinking you can change it all.

I wasn't sure, but I could guess. The man in the park was a body broker for pharmaceuticals and nonprofits, and behind him somewhere was a species resurrection group that somehow had the money. He'd gotten a hefty three hundred percent, which meant the investment was already thirty-six grand. He'd spent some of his twenty-seven paying off a few W&I people in the biggest counties, gotten a couple dozen names on high-V.R. searches, watched the best bets himself, and finally made his selection.

The group behind him didn't know how such things worked or didn't particularly care; they simply wanted consenting women of childbearing age, good health, no substance abuse, no walljackers, no suicidal inclinations; and the broker's reputation was good, and he did his job.

Somehow he'd missed the husband.

As I found out later, she was one of ten. Surrogates for human babies were a dime a dozen, had been for years. This was something else.

In a nation of two hundred eighty million, Lissy Tomer was one of ten—but in her heart of hearts she was the only one. Because a man who said he loved animals had talked to her in a park once. Because he'd said she would get a lot of money—money that ought to make a husband who was never happy, happy. Because she would get to see it when it was born and get to visit it wherever it was kept.

The odd thing was, I could understand how she felt.

I called Antalou at three A.M., got her mad but at least awake, and got her to agree we should try to get the girl out that same night—out of that room, away from the press, and into a County unit for a complete fetal check. Antalou is the kind of boss you only get in heaven. She tried, but Mendoza stonewalled her under P.C. Twenty-two, the Jorgenson clause—he was getting all the publicity he and his new unit needed with the press screaming downstairs—and we gave up at five, and I went home for a couple hours of sleep before the paperwork began.

I knew that sitting there in the middle of all that glass with two armed medics was almost as bad as the press, but what could I do, Lissy, what could I do?

I should have gone to the hotel room that night, but the apartment was closer. I slept on the sofa. I didn't look at the bedroom door, which is always locked from the outside. The nurse has a key. Some days it's easier not to think about what's in there. Some days it's harder.

I thought about daughters.

We got her checked again, this time at County Medical, and the word came back okay. Echomytic bruises with some placental bleeding, but the fetal signs were fine. I went ahead and asked whether the fetus was a threat to the mother in any case, and they laughed. No more than any human child would be, they said. All you're doing is borrowing the womb, they said. "Sure," this cocky young resident says to me, "it's low-tech all the way." I had a lot of homework to do, I realized.

Security at the hospital reported a visit by a man who was not her husband, and they didn't let him through. The same man called me an hour later. He was all smiles and wore a suit.

I told him we'd have to abort if County, under the Victims' Rights Act, decided it was best or the girl wanted it. He pointed out with a smile that the thing she was carrying was worth a lot of money to the people he represented, and they could make her life more comfortable, and we ought to protect the girl's interests.

CONTINUED ON PAGE 124

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"They come in threes, often arriving or departing in black Cadillacs or other large, dark-colored sedans."

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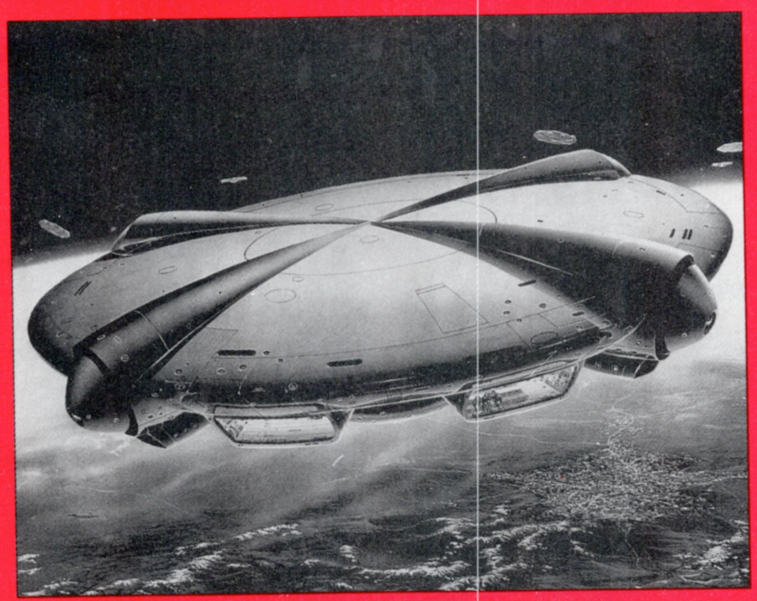

UFO UPDATE

Supernatural lore is full of phantom intimidators; so is UFOlogy, with its tales of mysterious men in black (MIB). Such stories date back to at least 1953, when Bridgeport, Connecticut, factory clerk Albert K. Bender, founder and director of the International Flying Saucer Bureau, claimed he had been visited by three men dressed in black suits.

According to Bender, the MIB not only revealed the secret of flying saucers, but they also intimated he'd end up in jail if he told anyone else. Suitably impressed, Bender folded his burgeoning bureau and headed off to Los Angeles. And in the last issue of the group's newsletter, *Space Review*, he cryptically warned "those engaged in saucer work to please be very cautious."

Bender may well have been an eccentric, but his case was hardly unique. Many UFO investigators claim that MIB plague them to this day. "The curious thing," says Peter Rojewicz, a folklorist who has studied the phenomenon, "is that MIB sometimes show up *before* the witness has had a chance to report a UFO sighting. They often have intimate information about the percipient that only he or a family member would normally have access to. And they customarily identify themselves as military-intelligence officers."

Rojewicz, now an assistant professor of humanities at The Juilliard School in New York, first became fascinated by MIB stories and the people who told them in the early Eighties while researching a doctoral thesis on UFO folklore at the University of Pennsylvania. His studies revealed a series of bizarre, if contradictory, patterns.

"Ninety-nine percent of the MIB are men," Rojewicz says. "Invariably they are dressed in black clothes that appear either neatly pressed or like they haven't been ironed in weeks. They customarily come in threes, often arriving or departing in black Cadillacs or other large, dark-colored sedans."

One anonymous source told Rojewicz of an unsettling encounter that took place in a university library reading room. A singular male figure dressed in a white shirt, black suit, and a "black, Texanlike string tie" tried to engage the researcher in a casual conversation about UFOs. "I told him I didn't much care whether they were real, physical flying craft or not but that I found stories about them interesting," said Rojewicz's source. "Well, I thought the guy was going to come unglued! He became highly agitated. 'Flying saucers are the most important fact of the century,' he shouted, 'and you're not interested?' "

Not everyone within the UFO community accepts the existence of men in black. "I've tried everything I know in the last thirty years to get them interested in me, without a nibble," says James Moseley, who publishes the irreverent and iconoclastic broadsheet *Saucer Smear*.

Despite Moseley's lack of a personal encounter, Rojewicz correlates the chances of confronting the MIB with the individual's degree of UFO involvement. He advises, however, not to fret if it happens to you: "Keep a sense of humor about yourself. Don't get upset or take them too seriously. In other words, don't feed the phenomenon."—*DENNIS STACY*

TROPICAL TORTS

It may be Hawaii, but Gharith Pendragon, local clairvoyant and parapsychology instructor, doesn't have much aloha spirit for Kurt Butler and his band of Honolulu Skeptics. Pendragon is suing for $1.5 million.

It's not just Butler, though. Pendragon's suit also names the University of Hawaii, the Hawaii Skeptics Organization, various skeptical professors at the University of Hawaii, the Committee for the Scientific Investigation of Claims of the Paranormal (CSICOP), magician James Randi, and Paul Kurtz, head of CSICOP. Before Pendragon gets a cent, he'll have to prove the skeptics and the university conspired to deprive him of his right to teach his noncredit parapsychology courses, and that in the process he was defamed. According to Butler, the skeptics don't frown on objective courses in parapsychology. What irked them were courses that purported to teach psychic skills.

With respect to the case, Pendragon thinks a defeat would be tantamount to declaring open season on parapsychology and paranormal practitioners everywhere. Butler, on the other hand, feels a loss for the defendants would have a "chilling effect" on skeptics throughout the country.

It is probably safe to say that neither side will be having much fun in the sun between now and the June trial.

—Paul McCarthy

MONSTER RATS

According to the Tehran newspaper *Kayhan*, Iran has developed a *big*—as in monster-size—rodent problem. Environmentalists in that country recently reported that giant rats weighing an average of 26 pounds are killing and devouring cats. Some of the creatures, the newspaper states, have unusually long hind legs and hop like kangaroos.

William Jackson, professor of biological sciences at Bowling Green State University in Bowling Green, Ohio, suspects the Iranian rodents may be similar to the giant rats known as cane cutters, which are frequently used for food in West Africa. But reports of the rodents' bloodthirsty appetites and occasional hopping remain baffling, Jackson adds. "The giant rats in Africa are vegetarians, and I find the fact that these huge Iranian rats are supposedly demonstrating aggressive behavior very strange."

—Sherry Baker

LEAVING THE BODY

Some experts think you're born with the power to have out-of-body experiences (OBEs). But Rex Stanford, a psychology professor at Saint John's University in Jamaica, New York, believes that some people could be conditioned to have them.

Stanford bases his opinion on a recent survey in which several college students filled out a questionnaire dealing with childhood experiences and were asked whether they'd ever left their bodies. They were specifically asked how much time they had spent reading and how often they had played imaginary games by themselves or with imaginary playmates. They were questioned about early attachments to dolls or stuffed animals and about how they had dealt with punishment.

The New York researcher found that his results followed a pattern. Children who spent considerable time reading and playing with imaginary playmates tended to report out-of-body experiences later in life. To Stanford, these results suggest that far from being a literal separation of the mind from the body, OBEs could result from the use of fantasy.

"The findings of this study suggest that the OBE involves the imagination," says Stanford, although not all fantasy-prone individuals report OBEs.

Indeed, notes Keith Harary, director of the Institute for Advanced Psychology in San Francisco, who says he can induce such experiences at will. "If a child is sensitive and has a rich inner life," Harary points out, "he's going to have imaginal experiences. But that doesn't mean that the out-of-body experience is necessarily imaginal. His sensitivity might lead him to have both fantasy experiences and very real OBEs."—D. Scott Rogo

"Out of her own body she pushed silver thread, light, air."

—Paula Gunn Allen

PSYCHIC BLUE EYES

You can change the color of your eyes thanks to tinted contact lenses. But psychic Jan Craddock of Atlanta insists she's found something else that makes her brown eyes blue—ESP.

Eleven years ago, according to Craddock, she began to hear the voices of spirit guides. "I was considering becoming a professional psychic, and I thought it was a shame that I didn't have blue eyes, because all my psychic teachers had clear, piercing blue eyes," she recalls. "Then the voices said, 'We'll give you blue eyes. . . .' "

Within a week, Craddock says, her eyes began to look blue—only it wasn't her irises that changed color but her *eyeballs*. She claims that medical exams showed no physical abnormalities.

Don and Ann Chandler of Carrollton, Georgia, who have had psychic readings performed by Craddock, say they've observed her chameleonlike eyeballs. "We definitely noticed it," notes Ann Chandler. "The whites developed a blue cast."

Craddock points out that the blue color comes and goes, with one eye sometimes appearing more blue than the other. "They get bluer when I'm in an altered psychic state," she says.

Not everyone is convinced that Craddock's colorful eyeballs have anything to do with alleged supernatural talents, however. "If a person had a delay of blood to the optic nerve," notes Atlanta ophthalmologist Thomas Schermerhorn, "it could give the eyeballs a bluish cast. Also, if someone holds his breath for one or two minutes, that could turn the eyeball color more blue."

—Sherry Baker

"The artist solicits the spectator's optic nerve. By methodically organizing his colors, he engages and disturbs his visual system."

—editors of Realities

"Color got me."

—Paul Klee

ANTI MATTER

BEAST-AND-BREAKFAST INN

The Kittiwell Hotel, located in western England's Exmoor region, offers more than the traditional bed-and-breakfast. Now tourists can take advantage of a four-day *beast*-and-breakfast deal. For $200, you get full board and a guided tour of the bleak moors and hills where the mysterious Beast of Exmoor is said to roam.

Described as a huge black cat, the Beast gained local notoriety when press reports blamed a 1983 killing of more than 100 sheep on the creature. Over the past year, sightings of the elusive beast have increased—witnesses claim it leapt over an eight-foot-tall hedge and prowled within 20 feet of a car. Naturalist Trevor Beer, who conducts guided tours of the Beast's alleged habitat, recently had a close encounter with the creature and snapped several color pictures of a large, pumalike cat as it hunted rabbits on a hillside.

Beer points out that the North Devon and Somerset counties of England, where the Beast of Exmoor is said to roam, have long been associated with superstitions about phantom creatures that haunt the moors. But he claims the Beast of Exmoor is a flesh-and-blood creature—or creatures: "I think that over the years big cats have escaped from circuses and exotic pet situations," he explains. "And now we have a feral breeding population in the British Isles."

Loren Coleman, a cryptozoologist who has investigated unexplained sightings of large cats in the United States, offers another theory: "There may be a relic population of Ice Age lions that somehow survive in a few parts of the world. The female cats would be very dark, like the descriptions of the Beast of Exmoor."

Wherever they came from, Beer hopes the cats are protected. "I'm volunteering to give these tours because I want to attract sympathy for the cats. I don't think they are responsible for the sheep killings. I think packs of rogue dogs are to blame," he says. "These cats are just living in the wild, perfectly free, doing no one any harm."—Sherry Baker

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"I am convinced that beings from another planet have singled out Titan as a space station."

—Sergei Bozhich, astrophysicist

STRANGENESS OSCARS

That the mantis has but one ear is odd. But that the British royal family is related to Vlad the Impaler, the original Dracula, is strange. Making such fine distinctions, Mark Chorvinsky, magician, filmmaker, and editor of the new publication *Strange Magazine*, has compiled a list of the ten strangest events of the past year.

The list pushes most of the right buttons. For parapsychologists, there is the year's major ghost case, the hauntings reported at Magdalen College in Oxford, England.

Japan took several honors, including one for a Labor Ministry report probing ten deaths caused by robots and another for a seer who said he heard the voice of God on a bullet train predicting Japan's next prime minister: Noboru Takeshita.

But the winner of Chorvinsky's "Hard to Believe" award is pure Americana: the little-publicized claim by Oral Roberts that he has raised a baby from the dead.

To come up with this first top-ten compilation (complete list available from Box 2246, Rockville, MD 20852), Chorvinsky and his staff of experts on unusual phenomena searched through thousands of cases, choosing only those items that were particularly controversial, deliciously mysterious, or, as surrealists would say, disquietingly strange.

Not so strangely, the list's year runs from October to October and is released at Halloween. "I think there is a lot of prejudice against the strange," says Chorvinsky, "except on this date." But his *Strange Magazine*, with its stories of death rays, real-life blobs, and state-of-the-art techniques for hunting lake monsters, promises to be a year-round haven for the inexplicable. "I enjoy mysteries," Chorvinsky admits. "Otherwise, why would I be a professional magician?"

—Patrick Huyghe

"She had on those damn fakies that point all over the place, but you felt sort of sorry for her."

—J. D. Salinger

"In which the yo-yo string is revealed as a state of mind."

—Thomas Pynchon

"I've been trying for some time to develop a life-style that doesn't require my presence."

—Garry Trudeau

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BUDDHA

CONTINUED FROM PAGE 62

Taboo pulled out a packet of white powder and a drinking straw and told Buddha to toot a few lines, to put a shine on his high. Buddha did as he suggested. A luxuriant warmth spread through his head and chest, and little sparkles danced in the air, vanishing like snowflakes. He started getting drowsy. Taboo steered him to the bed, then curled up beside him, his arm around Buddha's waist.

"I love you so much, Buddha," he said. "Don't know what I'd do without you to talk to . . . I swear I don't." His soft breasts nudged against Buddha's arm, his fingers toyed with Buddha's belt buckle, and despite himself, Buddha experienced the beginnings of arousal. But he felt no love coming from Taboo, only a flux of lust and anxiety. Love was unmistakable—a warm pressure as steady as a beam from a flashlight—and Taboo was too unformed, too confused, to be its source.

"Naw, man," Buddha said, pushing Taboo's hand away.

"I just wanna love you!"

In Taboo's eyes Buddha could read the sweet, fucked-up sadness of a woman born wrong; but though he was sympathetic, he forced himself to be stern. "Don't mess wit' me!"

The buzzer sounded.

"Damn!" Taboo sat up, tucked in his shirt. He walked over to the table, picked up the white powder and the drinking straw, and brought them over to Buddha. "You do a little bit more of this here bad boy. But don't you be runnin' it. I don't want you fallin' out on me." He went out into the living room, closing the door behind him.

There seemed to be a curious weight inside Buddha's head, less an ache than a sense of something askew, and to rid himself of it he did most of the remaining heroin. It was enough to set him dreaming, though not of Africa. These dreams were ugly, featuring shrieks and thuds and nasty smears of laughter, and once somebody said, "The man got tits! Dig it! The man's a fuckin' woman!"

Gradually he arrived at the realization that the dreams were real, that something bad was happening, and he struggled back to full consciousness. He got to his feet, swayed, staggered forward, and threw open the door to the living room.

Taboo was naked and spread-eagled facedown over some pillow, his rump in the air, and Johnny Wardell—a young leather-clad blood with a hawkish face—was holding his arms. Another man, darker and heavier than Wardell, was kneeling between Taboo's legs and was just zipping up his trousers.

For a split second nobody moved. Framed by the vivid green grass and blue sky and innocent clouds, the scene had a surreal biblical quality, like a hideous act perpetrated in some unspoiled corner of the Garden of Eden, and Buddha was transfixed by it. What he saw was vile, but he saw, too, that it was an accurate statement of the world's worth, of its grotesque beauty, and he felt distanced, as if he were watching through a peephole whose far end was a thousand miles away.

"Lookit here," said Wardell, a mean grin slicing across his face. "The ho already done got herself a man. C'mon, bro'! We saved ya a piece."

Long-buried emotions were kindled in Buddha's heart. Rage, love, fear. Their onset too swift and powerful for him to reject. "Get your hand off him," he said, pitching his voice deep and full of menace.

Wardell's lean face went slack, and his grin seemed to deepen, as if the lustful expression engraved on his skull were showing through the skin, as if he perceived in Buddha an object of desire infinitely more gratifying than Taboo.

Wardell nodded at the man kneeling between Taboo's legs, and the man flung himself at Buddha, pulling a knife and swinging it in a vicious arc. Buddha caught the man's wrist, and the man's violence was transmitted through his flesh, seeding fury in his heart. He squeezed the man's wristbones until they ground together, and the knife fell to the floor. Then he pinned the man against the wall and began smashing his head against it, avoiding the fingers that clawed at his eyes. He heard himself yelling, heard bone splinter.

The man's eyes went unfocused, and he grew heavy in Buddha's grasp; he slumped down, the back of his head leaving a glistening red track across a puffy cloud. Buddha knew he was dead, but before he could absorb the fact, something struck him in the back, a liver punch that landed with the stunning impact of a bullet, and he dropped like a stone.

The pain was luminous. He imagined it lighting him up inside with the precise articulation of an X ray. Other blows rained in upon him, but he felt only the effects of that first one. He made out Wardell looming over him, a slim, leathery giant delivering kick after kick. Blackness frittered at the edges of his vision. Then a scream—a sound like a silver splinter driven into Buddha's brain—and there was Taboo, something bright in his hand, something that flashed downward into Wardell's chest as he turned, lifted, flashed down again. Wardell stumbled back, looking puzzled, touching a red stain on the shirtfront, and then appeared to slide away into the blackness at the corner of Buddha's left eye. Buddha lay gasping for breath: The last kick had landed in the pit of his stomach. After a second his vision began to clear, and he saw Taboo standing above Wardell's body, the other man's knife in his hand.

With his sleek breasts and male genitalia and the bloody knife, he seemed a creature out of a myth. He kneeled beside Buddha. "You awright?" he asked. "Buddha? You awright?"

"I can't help but believe that somewhere out there, there are millions of other bowls with millions of other intelligent goldfish in them."

Buddha managed a nod. Taboo's eyes reminded him of the eyes of the fish in his dream—aswarm with terrors—and his magic was heavy wash in the air, stronger than Buddha had ever seen it.

"I never wanted to kill nobody," said Taboo tremulously. "That's the *last* thing I wanted to do." He glanced at the two corpses, and his lips quivered. Buddha looked at them, too.

Sprawled in oddly graceful attitudes on the green grass amid a calligraphy of blood, they appeared to be spelling out some kind of cryptic message. Buddha thought if he kept staring at them, their meaning would come clear.

"Oh, God!" said Taboo. "They gon' be comin' for me, they gon' put me in jail! I can't live in jail. What am I gon' do?"

And to his astonishment, looking back and forth between the corpses and Taboo's magical aura, Buddha found he could answer that question.

The answer was, he realized, also the solution to the problem of his life; it was a means of redemption, one he could have arrived at by no other process than that of his fifteen-year retreat.

Its conception had demanded an empty womb in which to breed and had demanded as well an apprehension of magical principle: That had been supplied by his dream of Africa. And having apprehended the full measure of this principle, he further realized he had misunderstood the nature of Taboo's powers. He had assumed that they had been weakened by the wrongness of his birth and would mature once he went under the knife; but he now saw they were in themselves a way of effecting the transformation with a superior result, that they had needed this moment of violence and desperation to attain sufficient strength. Buddha felt himself filling with calm, as if the knowledge had breached an internal reservoir that had dammed calmness up.

"You need a disguise," he said. "And you got the perfect disguise right at your fingertips." He proceeded to explain.

"You crazy, Buddha!" said Taboo. "No way I can do that."

"You ain't got no choice."

"You crazy!" Taboo repeated, backing away. "Crazy!"

"C'mon back here!"

"Naw, man! I gotta get away, I gotta. . . ." Taboo backed into the door, felt for the knob, and—eyes wide, panic-stricken—wrenched it open. His mouth opened as if he were going to say something else, but instead he turned and bolted down the hall.

The pain in Buddha's back was throbbing, spreading a sick weakness all through his flesh, and he passed out for a few seconds.

When he regained consciousness, he saw Taboo standing in the doorway, looking insubstantial due to the heavy wash of magic around him; in fact, the whole room had an underwater lucidity, everything

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wavering, like a dream fading in from the immaterial. "See?" said Buddha. "Where you gon' go, man? You barely able to make it here!"

"I don't know, I'll . . . maybe I'll . . ." Taboo's voice, too, had the qualities of something out of a dream: distant and having a faint echo.

"Sheeit!" Buddha reached out to Taboo. "Gimme a hand up."

Taboo helped him to his feet and into the bedroom and lowered him onto the bed. Buddha felt as if he might sink forever into the black satin coverlet.

"Show me that new dress you bought," he said. Taboo went to the closet, pulled out a hanger, and held the dress against his body to display its effect. It was white silk, low-cut, with a scattering of sequins all over.

"Aw, man," said Buddha. "Yeah, that's *your* dress. You be knockin' the boys' eyes out wearin' that . . . if they could ever see it. If you'd just do what's right. You'd be too beautiful for Detroit. You'd need to get someplace south, place where the moon shines bright as the sun. 'Cause that's what kinda beautiful you gon' be. Moon beautiful. Miami, maybe. That'd suit ya. Get you a big white car, drive down by them fancy hotels, and let all them fancy people have a look at ya. And they gon' lay down and beg to get next to you, man. . . ."

As Buddha talked, conjuring the feminine future with greater seductiveness and invention than ever before, the heat haze of Taboo's magic grew still more visible, taking on the eerie, miragelike aspect of the mists beyond the lake in Buddha's Africa; and after Buddha had finished, Taboo sat on the edge of the bed, holding the dress across his lap. "I'm scared," he said. "What if it don't work?"

"You always been scared," said Buddha. "You bein' scared's what got them two men dead out there. Time for that to stop. You know you got the power. So go on!"

"I can't!"

"You ain't got no choice." Buddha pulled Taboo's head down gently and kissed him openmouthed, breathing into him a calming breath. "Do it," he said. "Do it now."

Hesitantly Taboo came to his feet. "Don't you go nowhere now. You wait for me."

"You know I will."

"Awright." Taboo took a few steps toward the bathroom, then stopped. "Buddha, I don't . . ."

"Go on!"

Taboo lowered his head, walked slowly into the bathroom, and closed the door.

Buddha heard the tub filling, heard the splashing as Taboo climbed into it. Then heard him begin to mutter his charms. He needed to sleep, to fix, but he kept awake as long as he could, trying to help Taboo with the effort of his will. He could feel the vibrations of the magic working through the bathroom door. Finally he gave in to the pressures of exhaustion and the throbbing in his back and drifted off to sleep; the pain followed him into the blackness of sleep, glowing like the core of his being. He woke sometime later to hear Taboo calling his name and spotted him in the darkest corner of the room—a shadow outlined by painted stars.

"Taboo?"

"It don't feel right, Buddha." Taboo's voice had acquired a husky timbre.

"C'mere, man."

Taboo came a step closer, and though Buddha was still unable to see him, he could smell the heat and bitterness of the herbs.

"It worked, didn't it?" Buddha asked. "It musta worked."

"I think. . . . But I feel so peculiar."

"You just ain't used to it is all. . . . Now c'mere!"

Taboo moved still closer, and Buddha made out a naked young woman standing a few feet away. Slim and sexy, with shoulder-length black hair and high, small breasts and a pubic triangle that showed no sign of ever having been male.

"Black drapes hid the windows, a black satin quilt covered the bed. Buddha sat soaking his wart in a crystal bowl filled with herb-steeped water, while Taboo sat beside him, muttering charms."

The air around Taboo was still and dark. No ripples, no heat haze. The magic had all been used.

"I told ya," said Buddha. "You beautiful."

"I ain't. . . . I just ordinary." But Taboo sounded pleased.

"Ordinary as angels," Buddha said. "That's how ordinary you are."

Taboo smiled. It was faltering at first, that smile, but it grew wider when Buddha repeated the compliment: the smile of a woman gradually becoming confident of her feminine powers. She lay down beside Buddha and fingered his belt buckle. "I love you, Buddha," she said. "Make me feel right."

Love was a steady flow from her, as tangible as a perfume, and Buddha felt it seeping into him, coloring his calm emptiness. On instinct he started to reject the emotion, but then he realized he had one more duty to fulfill, the most taxing and compromising duty of all. He reached down and touched the place between Taboo's legs. Taboo stiffened and pushed her hips against his finger.

"Make me feel right," she said again.

Buddha tried to turn onto his side, but the pain in his back flared. He winced and lay motionless. "Don't know if I can. I'm hurtin' pretty bad."

"I'll help you," she said, her fingers working at his buckle, his zipper. "You won't have to do nothin', Buddha. You just let it happen now."

But Buddha knew he couldn't just let it happen, knew he had to return Taboo's love in order to persuade her of her rightness, her desirability. As she mounted him, a shadow woman lifting and writhing against the false night of the ceiling stars, strangely weightless, he pinned his dead wife's features to her darkened face, remembered *her* ways, *her* secrets. All the love and lust he had fought so long to deny came boiling up from nowhere, annihilating his calm. He dug his fingers into the plump flesh of her hips, wedging himself deep; he plunged and grunted, ignoring the pain in his back, immersed again in the suety richness of desire, in the animal turbulence of this most alluring of human involvements. And when she cried out, a mournful note that planed away to a whisper, like the sound a spirit makes falling through eternity, he felt the profound satisfaction of a musician who by his dominance and skill has brought forth a perfect tone from chaos. But afterward as she snuggled close to him, telling him of her pleasure, her excitement, he felt only despair, fearing that the empty product of his years of ascetic employment had been wasted in a single night.

"Come with me, Buddha," she said. "Come with me to Miami. We can get us a house on the beach and . . ."

"Lemme be," he said, his despair increasing because he wanted to go with her, to live high in Miami and share her self-discovery, her elation. Only the pain in his back—intensifying with every passing minute—dissuaded him, and it took all his willpower to convince her of his resolve, to insist that she leave without him, for Taboo and his dead wife had fused into a single entity in his mind, and the thought of losing her again was a pain equal to the one inflicted by Johnny Wardell.

At last, suitcase in hand, she stood in the doorway, the temptation of the world in a white silk dress, and said, "Buddha, please won'tcha . . ."

"Damn it!" he said. "You got what you want. Now get on outta here!"

"Don't be so harsh wit' me, Buddha. You know I love you."

Buddha let his labored breathing be the answer.

"I'll come see ya after a while," she said. "I'll bring you a piece of Miami."

"Don't bother."

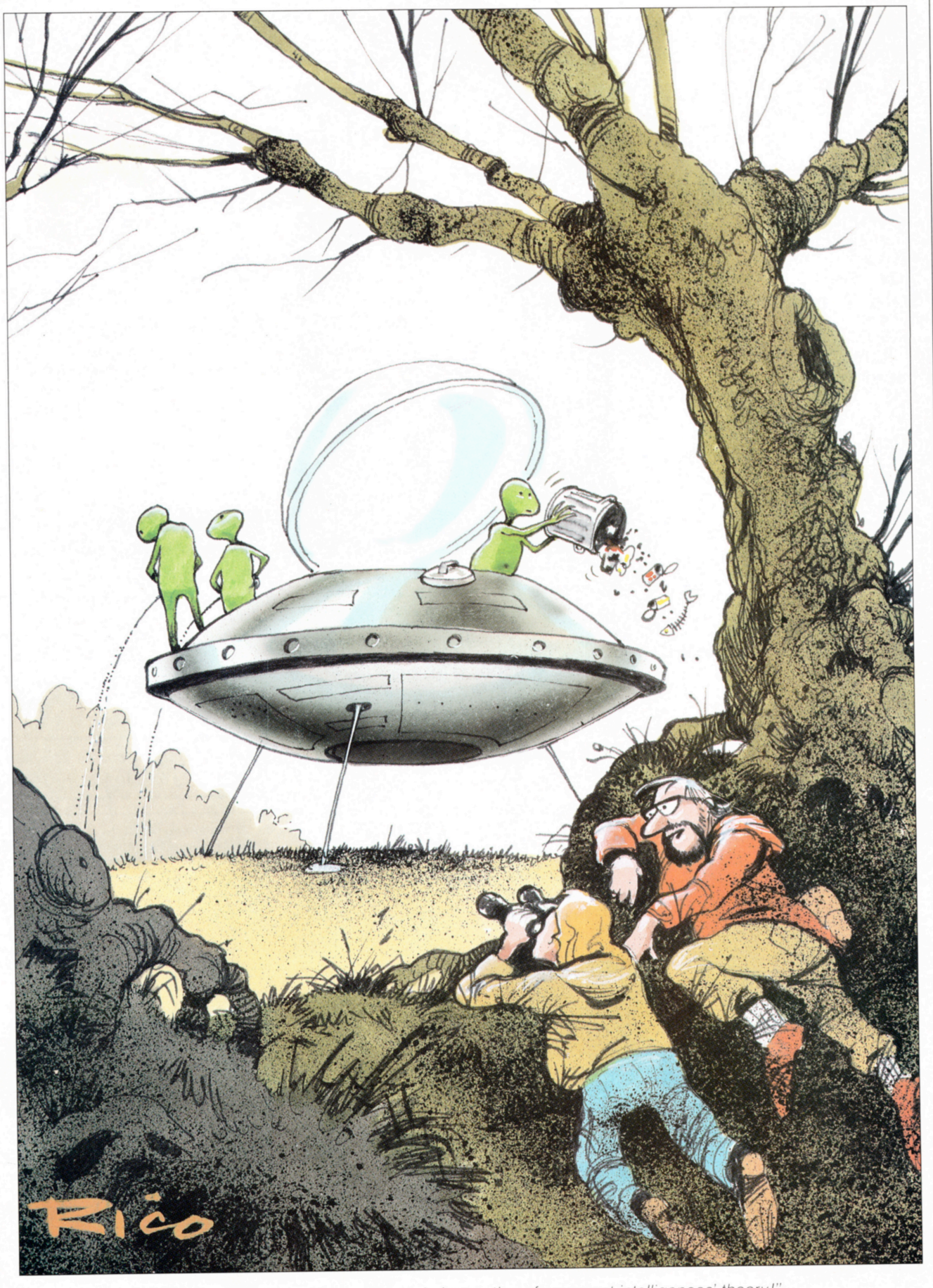
"Buddha?"

"Yeah."

"In the bathtub, Buddha . . . I just couldn't touch it."

"I'll take care of it."

She half-turned, glanced back. "I'll always love you, Buddha." The door swung shut behind her, but the radiance of her



"I guess this blows the 'concerned observation of emergent intelligences' theory!"

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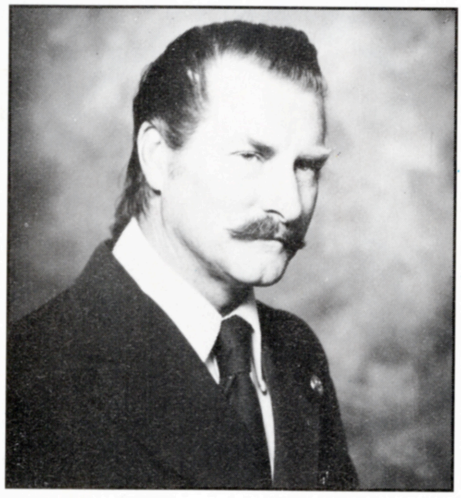

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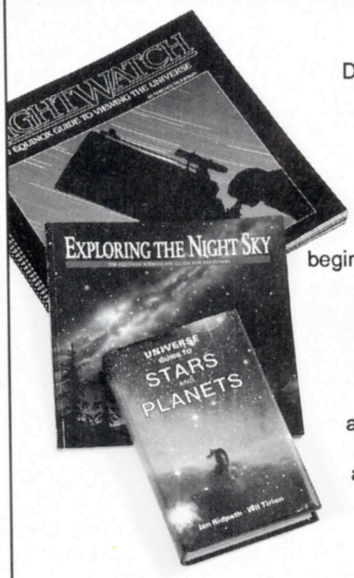

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love kept beaming through the wood, strong and contaminating.

"Go get yourself a big white car," he murmured.

He waited until he heard the front door close, then struggled up from the bed, clamping his hand over his liver to muffle the pain. He swayed, on the verge of passing out; but after a moment he felt steadier, although he remained disoriented by unaccustomed emotion. However, the sight of the pitiful human fragment lying in the herb-steeped water of the bathtub served to diminish even that. He scooped it up in a drinking glass and flushed it down the toilet. Then he lay back on the bed again. Closed his eyes for a minute . . . at least he thought it was just a minute. But he couldn't shake the notion that he'd been asleep for a long, long time.

Buddha had to stop and rest half a dozen times on the way back to the shooting gallery, overcome by pain, by emotions . . . mostly by emotions. They were all around him as well as inside.

The shadows of the ruined houses were the ghosts of his loves and hates; the rustlings in the weeds were long-dead memories with red eyes and claws just waiting for a chance to leap out and snatch him; the moon—lopsided and orange and bloated—was the emblem of his forsaken ambitions shining on him anew. By loving Taboo he had wasted fifteen years of effort and opened himself to all the indulgent errors of his past, and he wished to God now he'd never done it. Then, remembering how dreamlike everything had seemed, he had the thought that maybe it *hadn't* happened, that it had been a hallucination brought on by the liver punch. But recalling how it had felt to make love, the womanly fervor of Taboo's moves, he decided it had to have been real. And real or not, he had lived it, he was suffering for it.

When he reached the shooting gallery he sat cross-legged on his mattress, heavy with despair. His back ached something fierce. Pete was angry with him for being late, but on seeing his discomfort he limped upstairs and brought down a needle and helped him fix. "What happened to ya?" he asked, and Buddha said it wasn't nothin', just a muscle spasm.

"Don't gimme that shit," said Pete. "You get hit by a goddamn car, and you be tellin' me it ain't 'bout nothin'." He shook his head ruefully. "Well, to hell wit' ya! I'm sick of worryin' 'bout ya!"

Buddha began to feel drowsy and secure there on his mattress, and he thought if he could rid himself of the love that Taboo had imparted to him, things might be better than before. Clearer, emptier. But he couldn't think how to manage it. Then he saw the opportunity that the old man presented, the need for affection he embodied, his hollow heart.

Pete turned to go back up the stairs, and Buddha said, "Hey, Pete!"

"Yeah, what?"

"I love you, man," said Buddha, and sent his love in a focused beam of such strength that he shivered as it went out of him.

Pete looked at him, perplexed. His expression changed to one of pleasure, then to annoyance. "You *love* me? Huh? Man, you been hangin' out with that faggot too much, that's what you been doin'!" He clumped a couple of steps higher and stopped. "Don't bother comin' upstairs for your goodnighter," he said in gentler tones. "I'll send it down wit' somebody."

"'Preciate it," said Buddha.

He watched Pete round the corner of the stairwell, then lay down on the mattress. He was so free of desire and human connections that the instant he closed his eyes, golden pinpricks bloomed behind his lids, opened into Africa, and he was flying across the grasslands faster than ever, flying on the wings of the pain that beat like a sick heart in his back. The antelope did not run away but stared at him with wet, dark eyes, and the stick figures of those who guarded the village saluted him with their spears. The shadows of the masked women danced with the abandon of black flames, and in one of the huts a bearded old man was relating the story of a beautiful young woman who had driven a white car south to Miami and had lived wild for a time, had inspired a thousand men to greater wildness, had married and . . . Buddha flew onward, not wanting to hear the end of the story, knowing that the quality of the beginning was what counted, because all stories ended the same. He was satisfied that Taboo's beginning had been worthwhile. He soared low above the green mountains, low enough to hear the peaceful chants of the gorillas booming through the hidden valleys, and soon was speeding above the lake wherein the solitary fish swam a slow and celebratory circle, arrowing toward the mists on its far side, toward those hallucinatory borders that he previously had neither the necessary courage nor clarity to cross.

From behind him sounded a distant pounding that he recognized to be someone knocking on the door of the shooting gallery, summoning him to his duty. For an instant he had an urge to turn back, to reinhabit the world of the senses, of bluesy-souled hookers and wired white kids and punks who came around looking to trade a night's muscle work for a fix. And that urge intensified when he heard Pete shouting, "Hey, Buddha! Ain't you gon' answer the goddamn door?" But before he could act upon his impulse, he penetrated the mists and felt himself irresistibly drawn by their mysterious central whiteness, and he knew that when old Pete came downstairs, still shouting his angry question, the only answer he would receive would be an almost impalpable pulse in the air like the vibration of a gong whose clangor had just faded beneath the threshold of hearing, the pure signal struck from oblivion, the fanfare announcing Buddha's dominion over the final country of the mind.

NUCLEAR

CONTINUED FROM PAGE 48

needed to supply electricity in your area, would you favor a nuclear power plant, oppose a nuclear power plant, or reserve judgment until you had more information?" 30 percent of Gallup's interviewees opposed construction, and 50 percent said they would reserve judgment. Thirty-three percent of the subjects polled by Cambridge Reports opposed construction, and 49 percent reserved judgment.

The American Nuclear Society's John Graham likes to speak of the importance of perception. "*Perceived* is the key word," he says earnestly. "It's not reality that the nuclear community is fighting but the public's perception of what is real." Lovins thinks the success of "inherently safe" reactor programs depends on how much political muscle the industry will be able to exert. Lovins's scenario: The nuclear industry will come back to the public and the financiers saying, "Let us get it right the second time around so people won't have to worry about reactor safety." Lovins hopes an aware public will retort, "Why didn't you get it right the first time?"

BY THE RIVERSIDE

It's raining. Bad weather seems to follow me around when I visit nuclear power plants. I'm north of Portland, Oregon, touring the Trojan nuclear power plant, a 1,100-megawatt Westinghouse pressurized water reactor that uses the Columbia River as coolant. Owned by Portland General Electric Company (PGE) and Eugene Water & Electric, Trojan produces about a fifth of the electricity used in Oregon and has been online since 1976. Trojan is an impressive machine, the height of standard light-water reactor technology. It is one of a kind for Oregon because the state passed a law prohibiting further construction of nuclear plants until the federal government licenses a nuclear-waste repository.

"That puts us somewhere into the early part of the next century," a PGE spokesperson says. "That's a real problem," he adds. "When you look that far into the future, it's hard to say if the use of fission for producing electricity is even going to be a valid concern." Startling thought. The future of nuclear power could be advanced light-water reactors, or pebble-filled gas-cooled reactors, or PIUS reactors immersed in gargantuan pools of borated water, or integral fast reactors cooled with liquid sodium.

Given the recent newspaper reports stating that researchers have successfully ignited a nuclear fusion reaction in the Nevada desert, the dream of nuclear fusion may become real by the next century. Or solar-power satellites. Or geothermal plants. Or wind generation farms. Or Amory Lovins's dream of ultraefficient construction techniques and religiously practiced energy conservation.

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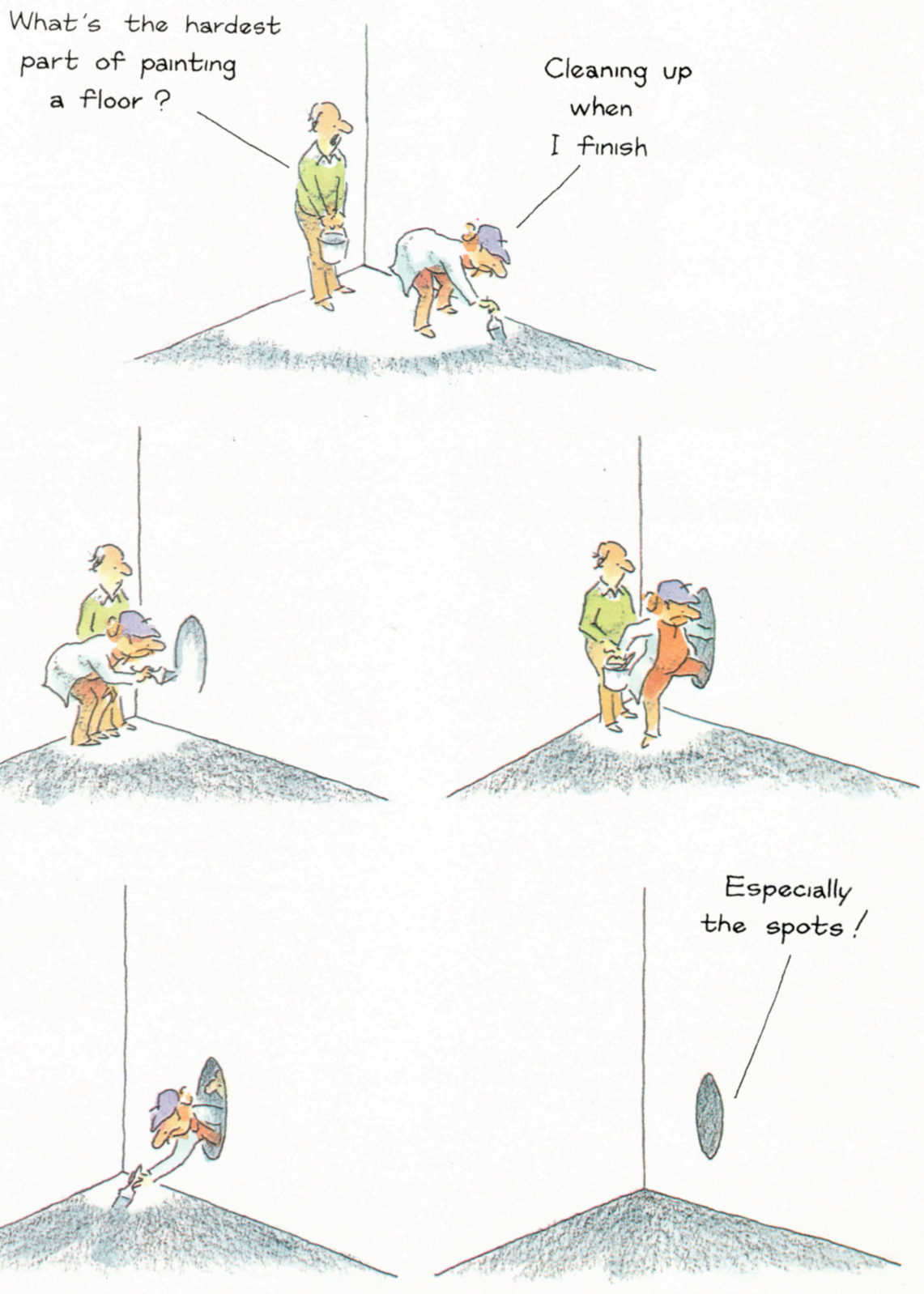

CONTINUED FROM PAGE 92

ist or a sadist to insist that we are really not very important or are just incidental to the whole thing, although that actually is often my own impression.

Omni: It doesn't all fit together.

Bell: I guess not! But it doesn't hurt me a lot, because I find I can live with the idea that there can be different departments of knowledge and that you don't have to make them all fit in one. I have actually discussed that more than I would have, because the Dalai Lama visited CERN once, and I was a member of the dinner party.

The dinner was a bit frustrating because it was clear that the Buddhists knew little about Western science, and the scientists little about Buddhism. It was clear that the Buddhists were *absolutely* inward looking. They were not trying to explain the mass of the electron or anything like that. They had their own tradition, and insofar as it has any bridge to Western science, it would be to psychology, because it's a discipline of personal salvation. Personal, spiritual expansion. There wasn't much communication, as I say, but the people were all friendly toward one another.

We sat at a long table; on one side were ten Buddhists, many in their saffron robes, including the Dalai Lama and his interpreter. Opposite them were ten physicists, the director general, the chief of the theory division, other important people, and myself—because they thought Bell's theorem might have something to do with Buddhism. The Dalai Lama, through his interpreter, said more or less that there could not be a conflict between Buddhism and science because both were looking for truth. I pressed him on the eternal recurrence. The Buddhists, he said, believe in metempsychosis on a personal level and on the scale of the universe—things repeat endlessly. The conception in physics at the moment, I told him, is that things began with a bang, and it happens only once. That's just a fashion—physicists could change their line easily. I asked the Dalai Lama whether Buddhists also could change their line. He said that if it became clear that physics was permanently committed to a once-only universe, then [imitating the sage] "the Buddhists would have to study their scriptures very carefully; there is usually room for maneuver!" [Laughs uproariously]

Omni: That must have been one of the odder spinoffs of your brand of physics.

Bell: The European branch of Maharishi University is here in Switzerland, in a little place called Seelisberg, overlooking Lake Lucerne. A number of people were invited to this meeting on religion, physics, quantum mechanics, consciousness, and so on. We all made little speeches, and Maharishi gave his comments. He was surrounded by acolytes—especially ladies in white robes—who said nothing and smiled admiringly on us all. That atmosphere, a mixture of piety and admiration, made me a bit uneasy. It's not the sort of atmosphere in which you can have a hard-hitting exchange of views. [Laughs] But they are vegetarians, and I'm a vegetarian, so I liked that. Maharishi is an extremely good-humored man. He laughs, makes wisecracks. Big smile. I remember somebody on Swiss television attempted to cross-examine him in a hostile way and mentioned all the money he makes. He said [switching to a high-pitched Yogi voice], "Oh, I know nothing about money. Anyway, however much there may be, it is not enough!"

Omni: What did you tell them?

Bell: My attitude is all very cold-blooded. I said you *can* make analogies between quantum mechanics and consciousness, but that these are no more than analogies. That thesis was received politely. They all nodded their heads and said nothing.

Omni: What do you think about spending your time with all of these people?

Bell: Mostly it's just good fun for me. Scientists should try to communicate with nonscientists; it's a proper activity. What my colleagues think about it, I can only guess. To me they are polite. Ah, I suspect they think it's not absolutely kosher, that it's not real science—that it's show business. I suspect that my reputation is damaged in their eyes by this side of my life.

It's a terrible tragedy that we are all so limited. Each of us has the ability to make some little contribution in a field in a lifetime of training and effort, and other people are doing that in other fields, and there is really so much that each of us does not participate in. Sometimes I'm just depressed by that. There's so little that I know about everything except physics and even except a small corner of physics. So I think it's natural and reasonable and right that at least in a nontechnical way we try to find out about what is happening elsewhere in the world. When people come to ask me what's happening in my world, I try to tell them—and I learn a bit about their world.

Omni: Yet you've said the incompleteness of quantum mechanics is a hard problem to do something major with—that people destroy their careers fixating on it.

Bell: But that's true of all big problems. Take the problem of free will. Nobody has the idea it's unimportant or trivial. But would you advise a person to make his career thinking about free will?

Omni: Do you think there are still big problems open in physics today?

Bell: Yes. And this particular question of locality is still open, in my opinion. I think we have not found a way of digesting this situation. We have the formulas of quantum mechanics, and they work extremely well; but I have not digested them. There certainly remains something to be said, some illumination to be found.∞

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TINY DANCERS

MIND

By Bibi Wein

At the age of five Wolfgang Amadeus Mozart, proficient on both the harpsichord and the violin, was composing minuets. At the age of seven, following an unprecedented European tour that included a performance at the imperial court in Vienna, he published four violin sonatas and two symphonies. Was Mozart's profound musical talent due, at least in part, to the fact that his father Leopold was a well-known violinist and composer and exposed his son to intensive musical stimuli from the day he was born?

If musical talent is inherited, no one has been able to prove it. But recent evidence suggests that a child's early environment may determine—perhaps even prenatally—the extent to which musical potential is realized.

Peter F. Ostwald, a professor of psychiatry at San Francisco's Langley Porter Psychiatric Institute, believes the brain mechanism for musical development may be activated when the baby is still in the womb. That environment, he says, is naturally musical: "The inside of the body—the central nervous system, for example—is rhythmic. The embryo feels the external sounds and rhythms of the mother: the pounding of her heart, her breathing, even the beat of her walk."

It's not surprising, then, that newborns, too, respond to sound and rhythm. Studies show that within 24 hours of birth, an infant can distinguish between his mother's voice and other sounds. In one of the most dramatic of these studies, Anthony DeCasper, a psychologist at the University of North Carolina at Greensboro, tested newborns with a nonnutritive nipple attached to a tape recorder. Sucking one way would bring forth the mother's voice. Sucking another way would elicit someone else's voice. The babies were quickly conditioned to suck the way that produced the voice of their own mother. Ostwald and others believe this evidence suggests that the recognition of acoustical patterns, a form of learning, probably begins sometime before birth.

For nearly eight years Donald Shetler, professor of education at the University of Rochester's Eastman School of Music and chairman of the cluster program on musical development and cognition, has been providing fetuses with musical stimuli. Recorded music with a single melodic line is played for the fetus through high-fidelity stereo earphones placed directly on the mother's abdomen.

"We tend to use orchestral music that's not too complex so that repeated patterns will be absolutely clear," says Shetler. "What we think the baby may use as a basis for further learning is the rhythmic and melodic pattern." More than half the mothers in the study, Shetler points out, report rhythmic movement of the fetal limbs in response to the pulse of the music.

For several dozen Rochester children, 30 of whom were subjects of his experiments while they were still in the womb, a monthly visit to Shetler has become routine. The hoary-headed Shetler, known around town as Eastman's grandpa, was the first to experiment with genuine music as opposed to electronic clicks and beeps and is the only one to date who tracks musical development from fetal stages to early childhood.

Rhythmic talent may be prenatally determined.

Shetler evaluates the musical response of newborns by looking at attention span and body movements. Later he measures the child's ability to imitate rhythms and vocal sounds and to manipulate such sound-making objects as small bells.

The sessions in Shetler's classroom—a music lab of tiny xylophones, drums, and musical toys—are videotaped for later analysis. Some of the children, he says, can imitate a two- or three-note melody within eight months of birth.

By the age of two, 80 percent of the children will play the lab's piano or synthesizer with one finger at a time, as opposed to banging several random keys at once. The children, he says, pick out different melodies and try them at different places on the piano, much the way a composer does. "It's not unusual for them to sing them," he says. "And the more exceptional children will replicate them on another instrument."

One of the most striking observations Shetler has made has more to do with speech than with music. "We've seen the development of highly organized and remarkably articulate speech in the experimental group," he says.

There is much speculation, however, and little hard data to prove a connection between music and language. Neurologists recognize that spoken language has a musical component. But what the neurologic mechanisms are that connect them is unknown.

"I think Shetler's studies are fascinating and certainly warrant larger longitudinal studies," says Frank Wilson, an author and assistant clinical professor of neurology at the University of California at San Francisco. Musical experiences, he says, do affect a child's socialization and development of self-perception. "A child may recognize individuals and begin to imitate sounds very early," he adds, "but I don't know that you can guarantee a child will speak more clearly, get a chair in the Philadelphia Orchestra, or be admitted to MIT more readily because of early musical exposure."

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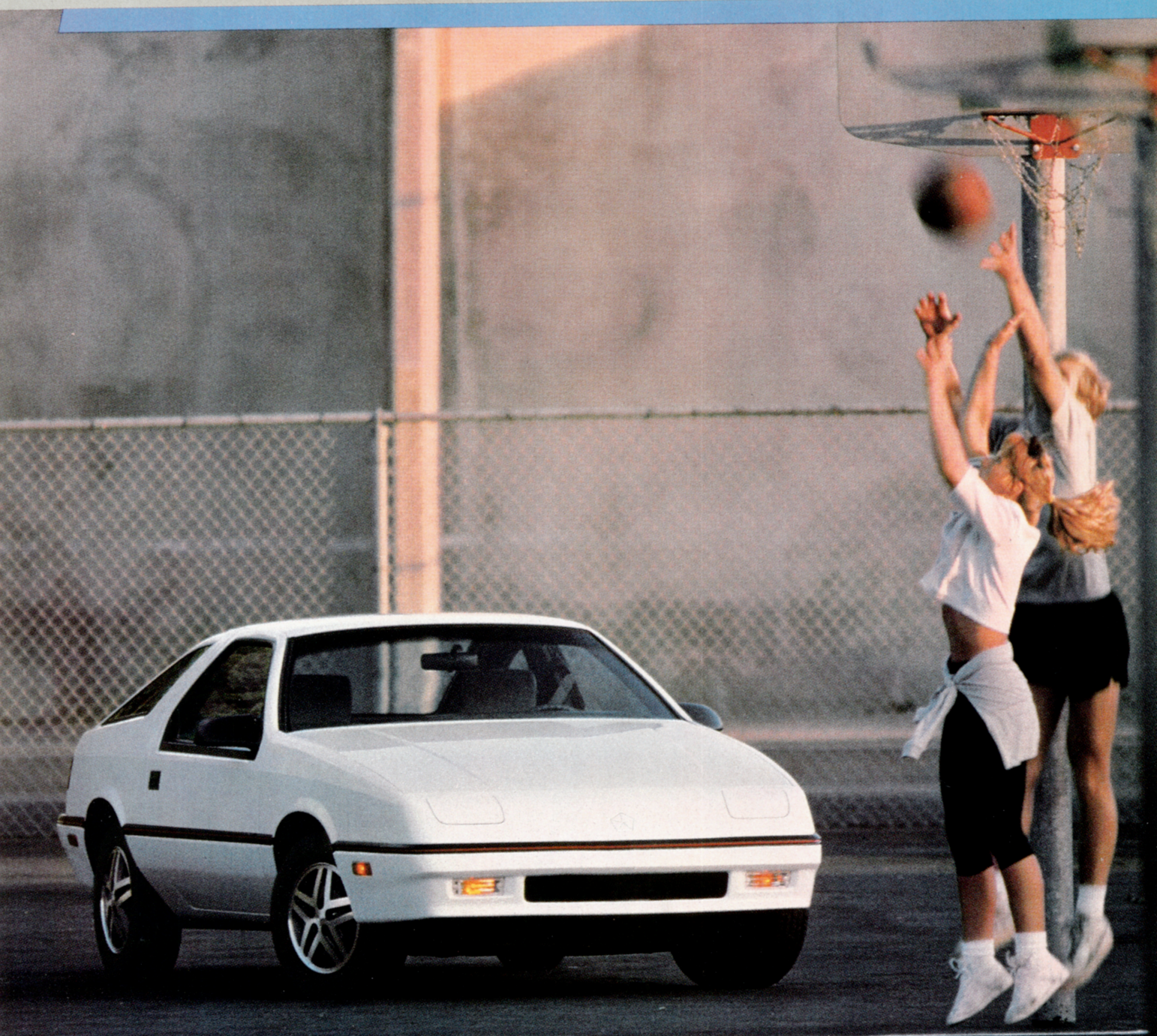

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BUCKLE UP FOR SAFETY.

ANIMALS

CONTINUED FROM PAGE 104

I told him what I thought of him, and he laughed. "You've got it all wrong, Doctor."

I let it pass. He knows I'm an MPS-V.R., no Ph.D., no M.D. He probably even knows I got the degree under duress, years late, because Antalou said we needed all the paper we could get if the department was going to survive. I know what he's doing, and he knows I know.

"The people I represent are caring people, Doctor. Their cause is a good one. They're not what you're accustomed to working with, and they've retained me simply as a program consultant, a 'resource locator.' It's all aboveboard, Doctor, completely legal, I assure you. But I really don't need to tell you any of this, do I?"

"No, you don't."

I added that, legal or not, if he tried to see her again I would have him for harassment under the D.A.'s cooperation clause.

He laughed, and I knew then he had a law degree from one of the local universities. The suit was right. I could imagine him in it at the park that day.

"You may be able to pull that with the mopes and 5150's you work with on the street, Doctor, but I know the law. I'll make you a deal. I'll stay away for the next three months, as long as you look after the girl's best interests, how's that?"

I knew there was more, so I waited.

"My people will go on paying for weekly visits up to the eighth month, then daily through to term, the clinic to be designated by them. They want ultrasound, CVS, and amniotic antiabort treatments, and the diet and abstinence programs the girl's already agreed to. All you have to do is get her to her appointments, and we pay for it. Save the county some money."

I waited.

His voice changed as I'd known it would. The way they do in the courtrooms. I'd heard it change like that a hundred times before, years of it, both sides of the aisle.

"If County can't oblige," he said, "we'll just have to try Forty-A, right?"

I told him to take a flying something.

Maybe I didn't know the law, but I knew Forty-A. In certain circles it's known simply as Fucker-Forty. Under it—the state's own legislation—he'd be able to sue the county and this V.R. advocate in particular for loss of livelihood—his and hers—and probably win after appeals.

This was the last thing Antalou or any of us needed.

The guy was still smiling.

"You've kept that face for a reason, Doctor. What do young girls think of it?"

I hung up on him.

With Antalou's help I got her into the Huntington on Normandy, a maternal unit for sedated Ward B types. Some of the other women had seen her on the news two evenings before; some hadn't. *It didn't matter,* I thought. *It was about as good a place for her to hide as possible,* I told myself. I was wrong. Everything's on computer these days, and some information's as cheap as a needle.

I get a call the next morning from the unit saying a man had gotten in and tried to kill her, and she was gone.

I'm thinking of the ones I've lost, Lissy. The tenth-generation maggot casings on the one in Koreatown, the door locked for days. The one named Consejo, the one I went with to the morgue, where they cut up babies, looking for hers. The skinny one I thought I'd saved, the way I was supposed to, but he's lying in a pool of O-positive in a room covered with the beautiful pink dust they used for prints.

Or the ones when I was a kid, East L.A., Fontana, the drugs taking them like some big machine, the snipings that always killed the ones that had nothing to do with it—the chubby ones, the ones who liked to read—the man who took Karenna and wasn't gentle, the uncle who killed his own nephews and blamed it on coyotes, which weren't there anymore, hadn't been for years.

I'm thinking of the ones I've lost, Lissy.

I looked for her all day, glad to be out of the apartment, glad to be away from a phone that might ring with a slick lawyer's face on it.

When I went back to the apartment that night to pick up another change of clothes for the hotel room, she was sitting cross-legged by the door.

"Lissy," I said, wondering how she'd gotten the address.

"I'm sorry," she said.

She had her hand on her belly, holding it not out of pain but as if it were the most comforting thing in the world.

"He wants to kill me. He says that anybody who has an animal growing in her is a devil and's got to die. He fell down the stairs. I didn't push him, I didn't."

She was crying, and the only thing I could think to do was get down and put my arms around her and try not to cry myself.

"I know, I know," I said. The symptoms were like Parkinson's, I remembered. You tripped easily.

I wasn't thinking clearly. I hadn't had more than two or three hours of sleep for three nights running, and all I could think of was getting us both inside, away from the steps, the world.

Maybe it was fatigue. Or maybe something else. I should have gotten her to a hospital. I should have called Mendoza for an escort back to his unit. What I did was get her some clothes from the bedroom, keep my eyes on the rug while I was in there, and lock the door again when I came out. She didn't ask why neither of us were going to sleep in the bedroom. She didn't

ask about the lock. She just held her belly, and smiled like some Madonna.

I took two Dalmanes from the medicine cabinet, thinking they might be enough to get the pictures of what was in that room out of my head.

I don't know whether they did or not. Lissy was beside me, her shoulder pressing against me, as I got the futon and the sofa ready.

Her stomach growled, and we laughed. I said, "Who's growling? Who's growling?" and we laughed again. I asked her if she was hungry and if she could eat sandwiches. She laughed again, and I got her a fresh one from the kitchen.

She took the futon, lying on her side to keep the weight off. I took the sofa because of my long legs.

I felt something beside me in the dark. She kissed me, said "Goodnight," and I heard her nightgown whisper back into the darkness. I held it in for a while and then couldn't anymore. It didn't last long. Dalmane's a knockout.

The next day I took her to the designated clinic and waited outside for her. She was happy. The big amnio needle they stuck her with didn't bother her, she said. She liked how much bigger her breasts were, she said, like a mother's should be. She didn't mind being careful about what she ate and drank. She even liked the strange V of hair growing on her abdomen, because—because it was hairy, she said, just like the thing inside her. She liked how she felt, and she wanted to know if I could see it, the glow, the one expectant mothers are supposed to have. I told her I could.

I'm thinking of a ten-year-old, the one that used to tag along with me on the median train every Saturday when I went in for caseloads while most mothers had their faces changed, or played, or mothered. We talked a lot back then, and I miss it. She wasn't going to need a lot of work on that face, I knew—maybe the ears, just a little, if she was picky. She'd gotten her father's genes. But she talked like me—like a kid from East L.A.—tough, with a smile, and I thought she was going to end up a D.A. or a showy defense type or at least an exec. That's how stupid we get. In four years she was into molecular opiates and trillazines, and whose fault was that? The top brokers roll over two billion a year in this city alone; the local *capi* net a twentieth of that, their street dealers a fourth; and God knows what the guys in the labs bring home to their families.

It's six years later, and I hear her letting herself in one morning. She's fumbling and stumbling at the front door. I get up, dreading it. What I see tells me that the drugs are nothing, nothing at all. She's running with a strange group of kids, a lot of them older. *This new thing's a fad,* I tell myself. It's like not having your face fixed—like not getting the nasal ramification modified, the mandibular thrust attended to—when you

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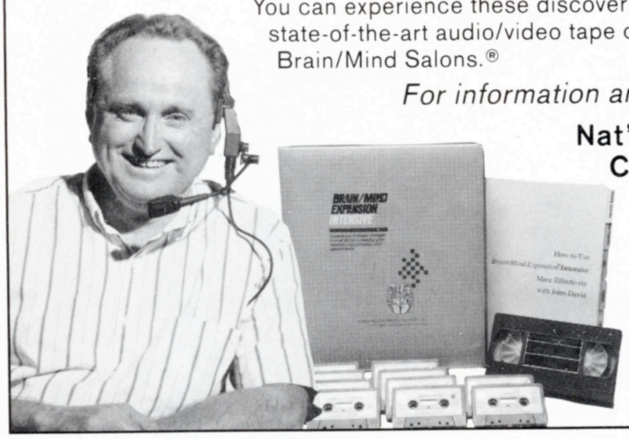

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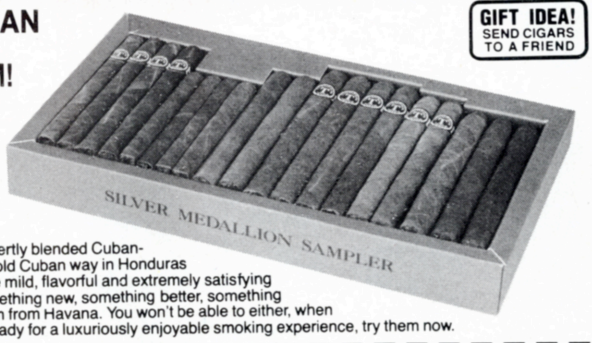

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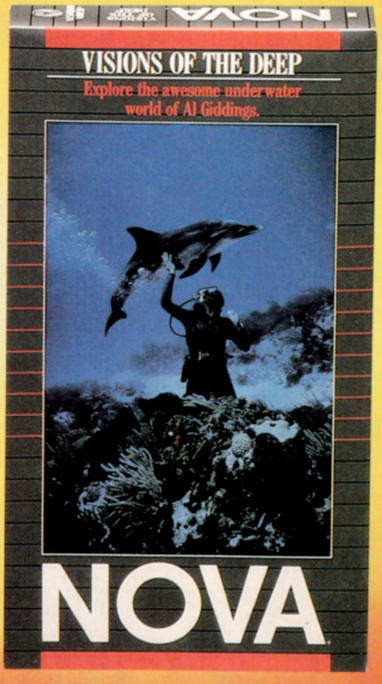

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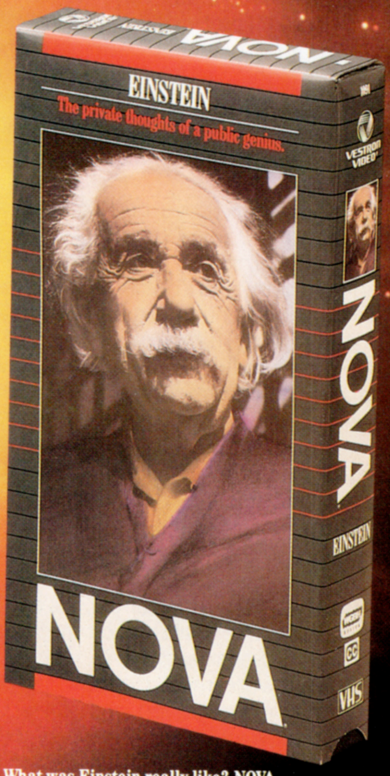

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could do it easily, anytime, and cheaply, just because you want to make a point, and it's fun to goose the ones who need goosing. *That's all she's really doing,* you tell yourself.

You've seen her a couple of times like this, but you still don't recognize her. She's heavy around the chest and shoulders, which makes her breasts seem a lot smaller. Her face is heavy; her eyes are puffy, almost closed. She walks with a limp because something hurts down low. Her shoulders are bare, and they've got tattoos now, the new metallic kind, glittery and painful. She's wearing expensive pants, but they're dirty.

So you have a daughter now who's not a daughter, or she's both, boy and girl. The operation cost four grand, and you don't want to think how she got the money. Everyone's doing it, you tell yourself. But the operation doesn't take. She gets an infection, and the thing stops being fun, and six months later she's got no neurological response to some of the tissues the doctors have slapped on her, and pain in the others. It costs money to reverse. She doesn't have it. She spends it on other things, she says.

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You try to find the ten-year-old in those eyes, and you can't.

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The call came through at six, and I knew it was County.

A full jacket—ward status, medical action, all of it—had been put through. The fetus would be aborted—"for the mother's safety . . . to prevent further exploitation by private interests . . . and physical endangerment by spouse."

Had Antalou been there, she'd have told me how County had already gotten flack from the board of supervisors, state W&I, and the attorney general's office over a V.R. like this slipping through and getting this much press. They wanted it over, done with. If the fetus were aborted, County's position would be clear—to state, the feds, and the religious groups that were starting to scream bloody murder.

It would be an abortion no one would ever complain about.

The husband was down at County holding with a pretty fibercast on his left tibia, but they weren't taking any chances. Word on two interstate conspiracies to kill the ten women had reached the D.A., and they were, they said, taking it seriously. I was, I said, glad to hear it.

Mendoza said he liked sassy women as much as the next guy, but he wanted her back in custody, and the new D.A. was screaming jurisdiction, too. Everyone wanted a piece of the ten o'clock news before the cameras lost interest and rolled on.

Society wasn't ready for it. The atavistic fears were there. You could be on trillazines, you could have an operation to be both a boy and a girl for the thrill of it, you could be a walljacker, but a mother like this, no, not yet.

I should have told someone but didn't. I took her to the zoo instead. We stood in front of the cages watching the holograms of the big cats, the tropical birds, the grass eaters of Africa—the ones that are gone. She wasn't interested in the real ones, she said—the pigeons, sparrows, coyotes, the dull hardy ones that will outlast us all. She never came here as a child, she said, and I believe it. A boyfriend at her one and only job took her once, and later, because she asked her to, so did a woman who wanted the same thing from her.

We watched the lions, the ibex, the white bears. We watched the long-legged wolf, the harp seals, the rheas. We watched the tapes stop and repeat, stop and repeat; and then she said, "Let's go," pulled at my hand, and we moved on to the most important cage of all.

There, the hologram walked back and forth looking out at us, looking through us, its red sagittal crest and furrowed brow so convincing. Alive, its name had been Mark Anthony, the plaque said. It had weighed two hundred kilos. It had lived to be ten. It wasn't one of the two whose child was growing inside her, but she seemed to know this, and it didn't matter.

"They all died the same way," she said to me. "That's what counts, Jo." *Inbred depression,* I remembered reading. *Petechial hemorrhages, cirrhosis, renal failure.*

Somewhere in the nation the remaining fertilized ova were sitting frozen in a lab, as they had for thirty years. A few dozen had been removed, thawed, encouraged to divide to sixteen cells, and finally implanted that day seven months ago. Ten had taken. As they should have, naturally, apes that we are. "Sure, it could've been done back then," the cocky young resident with insubordination written all over him had said. "All you'd have needed was an egg and a little plastic tube. And, of course,"—I didn't like the way he smiled—"a woman who was willing. . . ."

I stopped her. I asked her if she knew what The Arks were, and she said no. I started to tell her about the intensive-care zoos where for twenty years the best and brightest of them, ten thousand species in all, had been kept while two hundred thousand others disappeared—the toxics, the new diseases, the land-use policies of a new world taking them one by one—how The Arks hadn't worked, how two thirds of the macrokingdom were gone now, and how the thing she carried inside her was one of them and one of the best.

She wasn't listening. She didn't need to hear it, and I knew the man in the suit had gotten his yes without having to say these things. The idea of having it inside her, hers for a little while, had been enough.

She told me what she was going to buy with the money. She asked me whether I

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thought the baby would end up at this zoo. I told her I didn't know but could check, and hated the lie. She said she might have to move to another city to be near it. I nodded and didn't say a thing.

I couldn't stand it. I sat her down on a bench and told her what the County was going to do to her.

When I was through she looked at me and said she'd known it would happen, it always happened. She didn't cry. I thought maybe she wanted to leave, but she shook her head.

We went through the zoo one more time. We didn't leave until dark.

"Are you out of your mind, Jo?" Antalou said.

"It's not permanent," I said.

"*Of course* it's not permanent. Everyone's been looking everywhere for her. What the hell do you think you're doing?"

I said it didn't matter, did it? The County homes and units weren't safe, and we didn't want her with Mendoza, and who'd think of a soc worker's house—a P.D. safe house maybe, but not a soc worker's because that's against policy, and everyone knows that soc workers are spineless, right?

"Sure," Antalou said. "But you didn't *tell* anybody, Jo."

"I've had some thinking to do."

Suddenly Antalou got gentle, and I knew what she was thinking. I needed downtime, maybe some psychiatric profiling done. She's a friend of mine, but she's a professional, too. The two of us go back all the way to corrections, Antalou and I, and lying isn't easy.

"Get her over to County holding immediately—that's the best we can do for her," she said finally. "And let's have lunch soon, Jo. I want to know what's going on in that head of yours."

It took me the night and the morning. They put her in the nicest hole they had and doubled the security, and when I left she cried for a long time, they told me. I didn't want to leave, but I had to get some thinking done.

When it was done, I called Antalou.

She swore at me when I was through but said she'd give it a try. It was crazy, but what isn't these days?

The County bit, but with stipulations. Postpartum wipe. New I.D. Fine, but also a fund set up out of *our* money. Antalou groaned. I said, Why not.

Someone at County had a heart, but it was our mention of Statute Forty-A, I found out later, that clinched it. They saw the thing dragging on through the courts, cameras rolling forever, and that was worse than any temporary heat from state or the feds.

So they let her have the baby. I slept in the waiting room of the maternity unit, and it took local troops as well as hospital security to keep the press away. We used a teaching hospital down south—approved by the group that was funding her—but even then the media found out and came by the droves.

We promised full access at a medically approved moment if they cooled it, which they did. The four that didn't were taken bodily from the building under one penal code section or another.

At the beginning of the second stage of labor, the infant abruptly rotates from occiput-posterior to right occiput-anterior position; descent is rapid, and a viable two-thousand-gram female is delivered without episiotomy. Interspecific Apgar scores are nine and ten at one and five minutes, respectively.

The report would sound like all the others I'd read. The only difference would be how the thing looked, and even that wasn't much.

The little head, hairless face, broad nose, black hair sticking up like some old movie comic's. Human eyes, hairless chest, skinny arms. The feet would look like hands, sure, and the skin would be a little gray, but how much was that? To the girl in the bed it wasn't anything at all.

She said she wanted me to be there, and I said sure but didn't know the real reason.

When her water broke, they told me, and I got scrubbed up, put on the green throwaways like they said, and got back to her room quickly. The contractions had started up like a hammer.

It didn't go smoothly. The cord got hung up on the baby's neck inside, and the fetal monitor started screaming. She got scared; I got scared. They put her up on all fours to shift the baby, but it didn't work. They wheeled her to the O.R. for a C-section, which they really didn't want to do; and for two hours it was fetal signs getting better, then worse, doctors preparing for a section, then the signs somehow getting better again. Epidural block, episiotomy, some concerted forceps work, and the little head finally starts to show.

Lissy was exhausted, making little sounds. More deep breaths, a few encouraging shouts from the doctors, more pushing from Lissy, and the head was through, then the body, white as a ghost from the vernix, and someone was saying something to me in a weak voice.

"Will you cut the cord, please?"

It was Lissy.

I couldn't move. She said it again.

The doctor was waiting, the baby slick in his hands. Lissy was white as a sheet, her forehead shiny with the sweat, and she couldn't see it from where she was. "It would be special to me, Jo," she said.

One of the nurses was beside me saying how it's done all the time—by husbands and lovers, sisters and mothers and friends—but that if I was going to do it I needed to do it now, please.

I tried to remember who had cut the cord when Meg was born, and I couldn't. I could remember a doctor, that was all.

I don't remember taking the surgical steel

snips, but I did. I remember not wanting to cut it—flesh and blood, the first of its kind in a long, long time—and when I finally did, it was tough, the cutting made a noise, and then it was over, the mother had the baby in her arms, and everyone was smiling.

A woman could have carried a *Gorilla gorilla beringei* to term without a care in the world a hundred, a thousand, a million years ago. The placenta would have known what to do; the blood would never have mixed. The gestation was the same nine months. The only thing stopping anyone that winter day in '97 when Cleo, the last of her kind on the face of this earth, died of renal failure in the National Zoo in DC, was the thought of carrying it.

It had taken three decades, a well-endowed resurrection group, a slick body broker, and a skinny twenty-one-year-old girl who didn't mind the thought of it.

She wants money for the operation, my daughter says to me that day in the doorway, shoulders heavy, face puffy, slurring it, the throat a throat I don't know, the voice deeper. I tell her again I don't have it, that perhaps her friends—the ones she's helped out so often when she had the money and they didn't—could help her. I say it nicely, with no sarcasm, trying not to look at where she hurts, but she knows exactly what I'm saying.

She goes for my eyes, as if she's had practice, and I don't fight back. She gets my cheek and the corner of my eye, screams something about never loving me and me never loving her—which isn't true.

She knows I know how she'll spend the money, and it makes her mad.

I don't remember the ten-year-old ever wanting to get even with anyone, but this one always does. She hurts. She wants to hurt back. If she knew, if she only knew what I'd carry for her.

I'll find her, I know—tonight, tomorrow morning, the next day or two—sitting at a walljack somewhere in the apartment, her body plugged in, the little unit with its Medusa wires sitting in her lap, her heavy shoulders hunched as if she were praying, and I'll unplug her—to show I care.

But she'll have gotten even with me, and that's what counts, and no matter how much I plead with her, promise her anything she wants, she won't try a program, she won't go with me to County—both of us, together—for help.

Her body doesn't hurt at all when she's on the wall. When you're a walljacker you don't care what kind of tissue's hanging off you, you don't care what you look like—what anyone looks like. The universe is inside. The juice is from the wall, the little unit translates, and the right places in your skull—the medulla all the way to the cerebellum, all the right centers—get played like the keys of the most beautiful synthesizer in the world. You see blue skies that make you cry. You see young men and women who make you come in your pants

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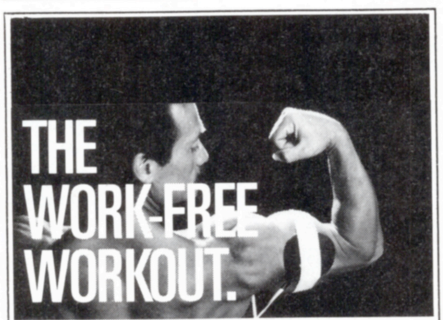

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without your even needing to touch them. You see loving mothers. You see fathers that never leave you.

I'll know what to do. I'll flip the circuit breakers and sit in the darkness with a hand light until she comes out of it, cold-turkeying, screaming mad, and I'll say nothing. I'll tell myself once again that it's the drugs, it's the jacking, it's not her. She's dead and gone and hasn't been the little girl on that train with her hair tucked behind her ears for a long time, that this one's a lie but one I've got to keep playing.

So I walk into the bedroom, and she's there, in the chair, like always. She's got clothes on for a change and doesn't smell, and I find myself thinking how neat she looks—chic even. I don't feel a thing.

As I take a step toward the kitchen and the breaker box, I see what she's done.

I see the wires doubling back to the wall-jack, and I remember hearing about this from someone. It's getting common, a fad.

There are two ways to do it. You can rig it so that anyone who touches you gets ripped with a treble wall dose in a bypass. Or so that anyone who kills the electricity, even touches the wires, kills you.

Both are tamperproof. The M.E. has twenty bodies to prove it, and the guys stuck with the job downtown don't see a breakthrough for months.

She's opted for the second. Because it hurts the most.

She's starving to death in the chair, cells drying out, unless someone I.V.'s her—carefully. Even then the average expectancy is two months, I remember.

I get out. I go to a cheap hotel downtown. I dream about blackouts in big cities and bodies that move but aren't alive and about daughters. The next morning I get a glucose drip into her arm, and I don't need any help with the needle.

That's what's behind the door, Lissy.

We gave them their press conference. The doctors gave her a mild shot of pergisthan to perk her up, since she wouldn't be nursing, and she did it, held the baby in her arms like a pro, smiled though she was pale as a sheet, and the conference lasted two whole hours. Most of the press went away happy, and two of Mendoza's girls roughed up the three that tried to hide out on the floor that night. "Mendoza says hello," they said, grinning.

The floor returned to normal. I went in.

The mother was asleep. The baby was in the incubator. Three nurses were watching over them.

The body broker came with his team two days later and looked happy. Six of his ten babies had made it.

Her name is Mary McLoughlin. I chose it. Her hair is dark, and she wears it short. She lives in Chula Vista, just south of San Diego, and I get down there as often as I can, and we go out.

She doesn't remember a thing, so I was the one who had to suggest it. We go to the zoo, the San Diego Zoo, one of the biggest once. We go to the primates. We stand in front of the new exhibit, and she tells me how the real thing is so much better than the holograms, which she thinks she's seen before but isn't sure.

The baby is a year old now. They've named her Cleo, and they keep her behind glass—two or three vets in gauze masks with her at all times—safe from the air and diseases. But we get to stand there, watching her like the rest, up close, while she looks at us and clowns.

No one recognizes the dark-haired girl I'm with. The other one, the one who'd have good reason to be here, disappeared long ago, the media says. Sometimes the spotlight is just too great, they said.

"I can almost smell her, Jo," she says, remembering a dream, a vague thing, a kitten slept with. "She's not full-grown, you know."

I tell her, yes, I know.

"She's sure funny looking, isn't she."

I nod.

"Hey, I think she knows me!" She says it with a laugh, doesn't know what she's said. "Look at how she's looking at me!"

The creature is looking at her—it's looking at all of us and with eyes that aren't dumb. Looking at us, not through us.

"Can we come back tomorrow, Jo?" she asks when the crowd gets too heavy to see through.

Of course, I say. We'll come a lot, I say.

I've filed for guardianship under Statute Twenty-seven, the old W&I provisions, and if it goes through, Lissy will be moving back to L.A. with me. *I'm hetero, so it won't get kicked for exploitation, and I'm in the right field,* I think. I can't move myself, but we'll go down to the zoo every weekend. It'll be good to get away. Mendoza has asked me out, and who knows, I may say yes.

But I still have to have that lunch with Antalou, and I have no idea what I'm going to tell her.∞

CREDITS

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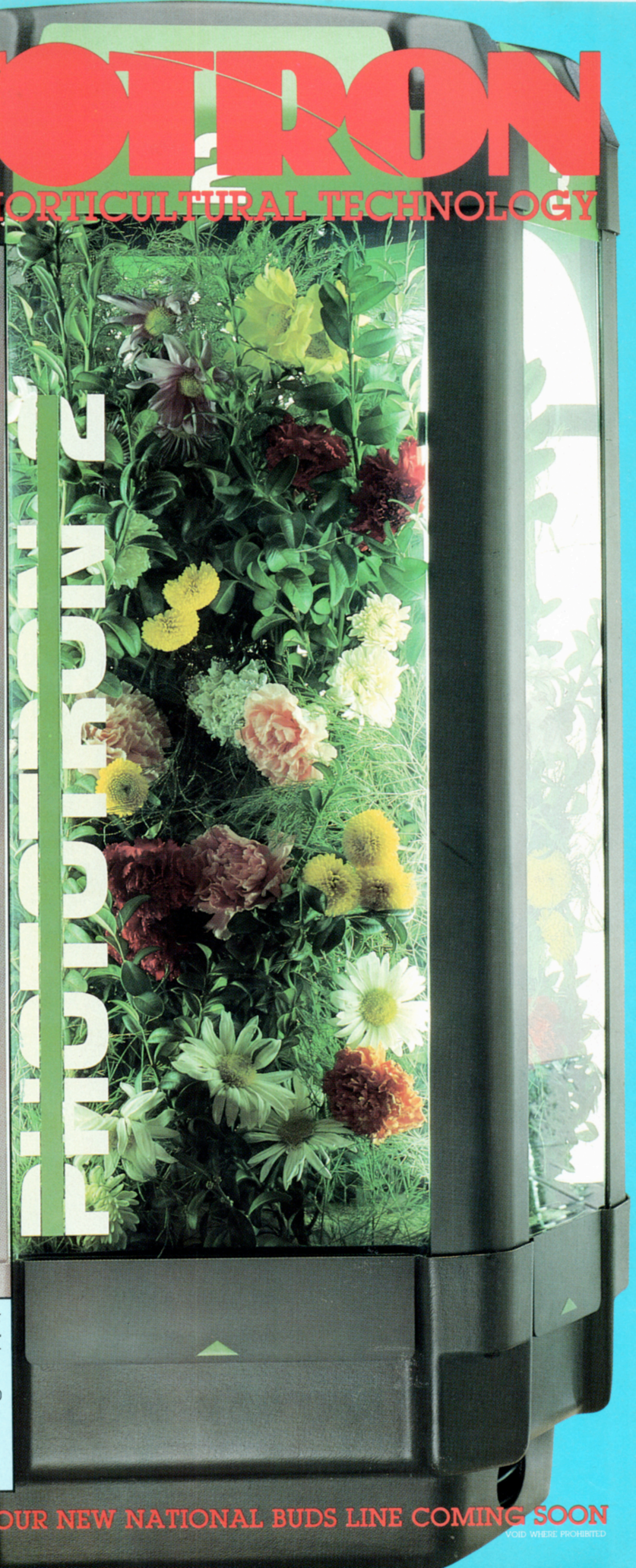
PHOTOTRON

LIGHT-YEARS AHEAD IN HORTICULTURAL TECHNOLOGY



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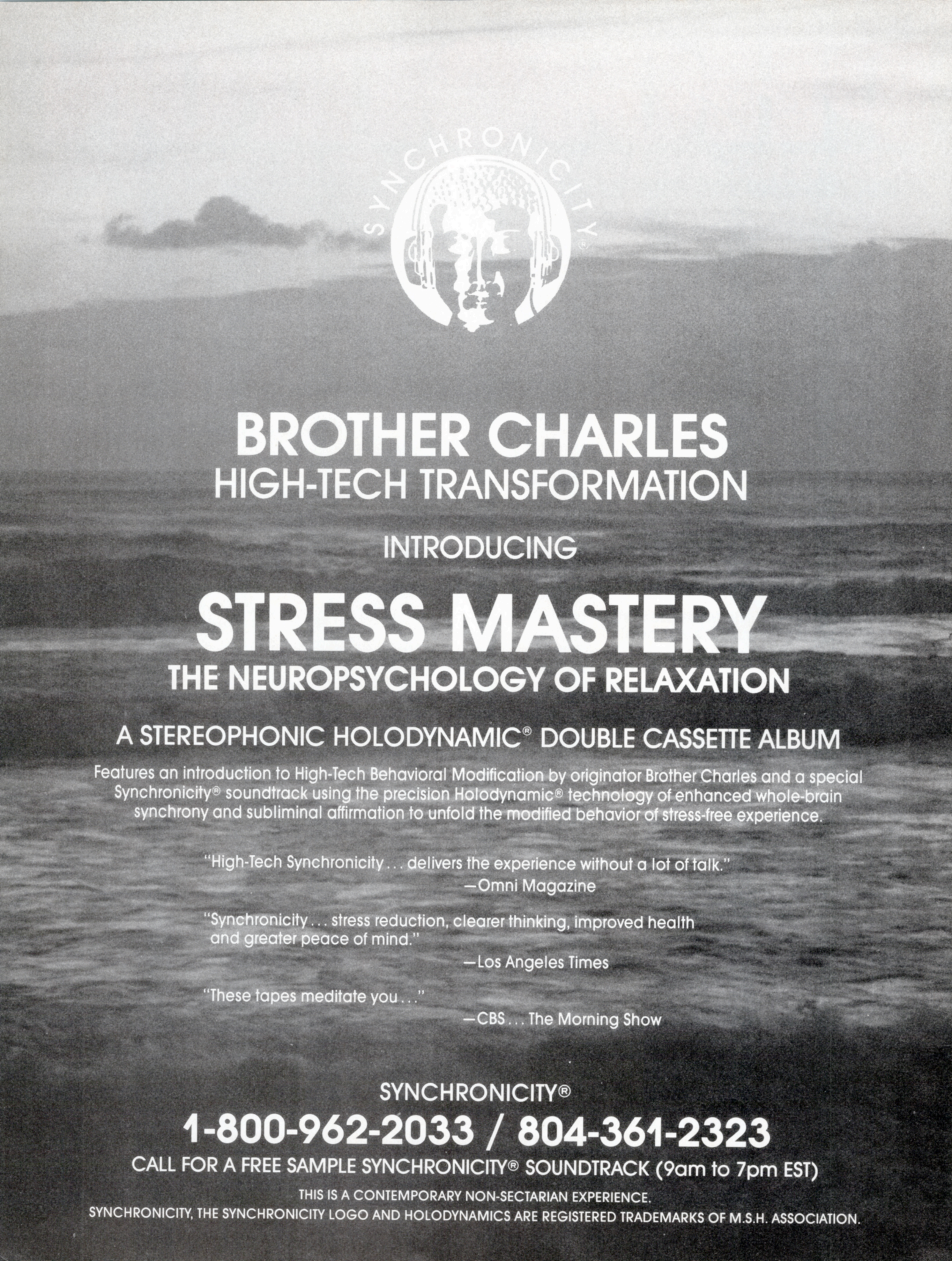
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"It's from home. 'Dear Alfred, hope you are having a nice voyage. Pity your ship had to leave so soon, you missed the parade and fireworks.' "

BODY

CONTINUED FROM PAGE 28

In 1987 Fisher and his team began working with Dr. Joseph Rosen, a Stanford University plastic surgeon, to develop medical uses for virtual environments. They are currently refining their first project, a computerized, three-dimensional human head with full skeletal details, for use in teaching anatomy. The constructs for the head are now being stored on a database, and Rosen has estimated that it should be available to students next year. He is already designing another version of the head to enable plastic surgeons to create computer models of candidates for surgical reconstruction. If a surgeon needs to take bone or tissue from elsewhere in the body to replace a damaged or deformed area on the face, for instance, he may identify eight possible sites for harvesting the material he needs. Using the virtual environment, he can try each site in turn to see which works best—a method he could never use on a real patient.

Because the VIEWS project is less than a year old, Fisher says he can't predict precisely when medical students around the country will begin training with virtual environments. "It will probably be within the decade," he adds.

Telesurgery, on the other hand, is expected to take considerably longer to implement. "Any use of telesurgery in space is very far off—maybe one hundred years, maybe fifty years, but not twenty years," says Dr. William DeCampli, a surgeon at Stanford University Medical Center who is also an astrophysicist and a member of the presidential Life Sciences Strategic Planning Study Committee as well as a member of NASA's new Space Station Science Advisory Subcommittee.

DeCampli believes that one medical use for virtual environments—as yet unexplored—might be in the rehabilitation of patients with neurological damage from stroke or illness. These patients must relearn such simple motor tasks as picking up dropped pencils. If they could use the virtual environment system with its electronic gloves, says DeCampli, it would accelerate the process of retraining their nervous systems. It would work like this: A physical therapist would be stationed at the controls. A patient would put his hands in the gloves. When the physical therapist released or contracted the muscles in his hand, the patient would "feel" those sensations. Fisher has talked with rehabilitation specialists about the possibility of using virtual environments to assess the movements a handicapped person can and cannot make within a particular setting—such as his apartment—as a step toward prescribing appropriate therapy.

DeCampli foresees a variety of ways in which virtual environments could be put to use to train medical students. One possibility he envisions is a series of "fantastic voyages." Wearing helmets, students could journey through veins and arteries, traversing neurons in a single bound, leaping synapses in the company of neurotransmitters, watching while blood cells engulf invaders in the bloodstream. The opportunities for studying the inner workings of the human body would be unparalleled.

"You could simulate a CT scan, place a tumor in the virtual environment, and have a medical student interpret it," DeCampli suggests. As a variation on this idea, he suggests creating a (virtual) trauma patient. Students could then analyze the patient's wounds, breathing patterns, EKG readings, and other data, making quick decisions just as they would in a true emergency situation. "The student could interact with the 'patient,' going through the motions of appropriate treatment, and the systems would give him the results of his actions," says DeCampli.

DeCampli and Fisher both stress their feeling that virtual-environment training will greatly enhance the education future generations of medical students receive. "They will definitely play a key role in medical teaching," DeCampli asserts. And if better training makes better doctors of the students, all of society should benefit.

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COMPUTER FISHING

For fishermen who spend half their time unsnarling lines, Ryobi, a Japanese company, has built computer circuitry into a battery-powered fishing reel (at right). The potassium, titanium oxide, and graphite reel ($85 to $100) monitors the speed of the spool as the fisherman casts, triggering a magnetic brake that eliminates entangling backlash.

—George Nobbe

SUPERANTENNA

A new FM antenna from Parsec of Wilmington, Delaware, uses a gallium arsenide field-effect transistor to improve signal strength while halving signal noise. Parsec president Steven E. Rosenthal says his LS-4 model (left) "boosts signal strength an incredible sixty-four times, well beyond the range of all other boosted FM antennas." Price: $59.95.

—George Nobbe

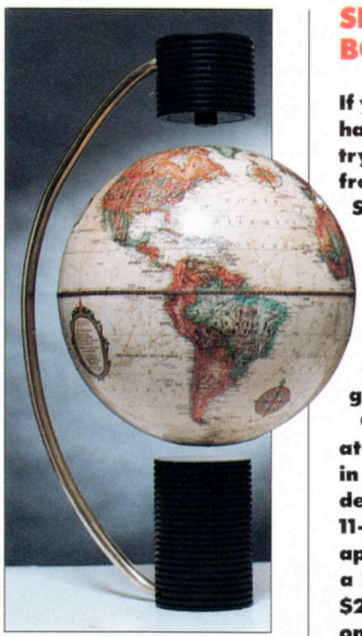
EYETYPER

The EyeTyper (right) lets those who can't speak "type" messages simply by looking at letters on an electronic keyboard. The letters then appear on a 40-character, single-line display screen, while a voice synthesizer speaks the message. The EyeTyper can control home appliances, and it even works on a personal computer. Sentient Systems Technology of Pittsburgh is the manufacturer, and the EyeTyper costs $3,495. —Bill Lawren

LEVITATING GLOBE

This six-inch world globe (right) floats in thin air. Pacific Levitation of Vancouver, British Columbia, uses a position sensor and an electromagnet to create the levitation effect. The novelty item will sell for $189.99, and the company is also working on a floating desk set.

—George Nobbe



SEASICKLESS BOAT

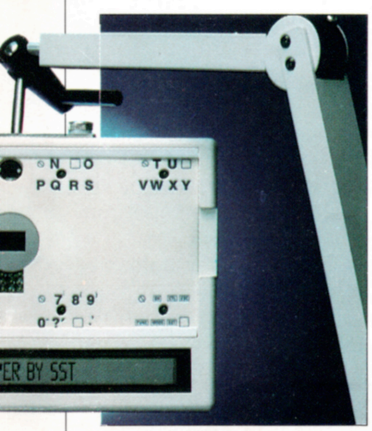
If you love yachting but hate getting seasick, try the 72-foot Chubasco from SWATH Ocean Systems in San Diego. It won't pitch or roll in heavy seas because the deck rides on four submerged hulls, each stabilized by a computerized gyroscope.

Chubasco (right) cruises at more than 20 knots in 6-foot seas, and its decks remain dry even in 11-foot waves. With appointments fit for a king, the price is $2,999,999, down one dollar from last year.

—Bob Mangino

BIKE RADIO

Some 25 states outlaw bicycling with earphones because they impair the cyclist's ability to hear traffic sounds that could warn of impending danger. One firm has now solved that problem with a bike stereo system consisting of a bracket with two small speakers that lock on to the handlebars. The cyclist adds his own Walkman. The Tune-Tote (right) is made by Novi Inc. of San Diego and sells for $24.95. For louder sound an advanced version, Tune-Tote Two ($34.95) has a booster amplifier powered by two AAA batteries.—Roger Field



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EARTH

CONTINUED FROM PAGE 18

evacuation plan impossible. Without Dukakis's approval of an evacuation plan, under NRC regulations, Seabrook could not operate. On December 3, 1987, however, the NRC voted to amend the criteria governing off-site emergency planning when state or local governments decline to participate, thereby doing away with Dukakis's yea or nay. The state of Massachusetts is expected to contest that ruling.

The Reverend *Jesse Jackson* is passionate in his support of the protection of our environment. He supports the Clean Air Act and believes that in order to reduce the hazards of radioactive waste, we should phase out nuclear power "to prevent nuclear accidents such as Three Mile Island and Chernobyl." By developing renewable forms of energy, Jackson states, we can cut down on the burning of fossil fuels, one of the major causes of acid rain. Although Jackson gets very good marks from environmentalists, he has no legislative record of accomplishment.

Senator *Albert Gore,* say experts, is probably the strongest candidate when it comes to environmental concerns. He chaired the investigative hearing that uncovered the hazardous-waste practices at New York State's Love Canal in 1978. He is also a principal author of Superfund.

In 1982 Gore was among the key legislators who uncovered corrupt practices at the Environmental Protection Agency (EPA). EPA administrator Anne Burford resigned under pressure after having been held in contempt of Congress for refusing to turn over documents subpoenaed by a congressional subcommittee. Gore also cited Rita Lavelle, manager of EPA's hazardous-waste programs, for contempt of Congress for refusing to testify. Lavelle was indicted for and convicted of perjury and obstruction of justice.

Senator *Paul Simon* has never been an environmental mover and shaker, say activists. Still, Simon submitted a bill to the Senate in 1987 that would require half of all the gasoline sold in this country to contain a 10 percent ethanol blend—a corn-based, clean-burning form of energy. Right now only about 7 percent of our gasoline contains an ethanol blend—although every new car sold in this country is already equipped to burn such a blend in gasoline. Simon claims that in addition to extending our oil supplies and making us less dependent on Middle East oil, ethanol gas will help curb air pollution. Environmentalists contend, however, that ethanol may further deplete the ozone layer.

Simon insists that high-sulfur coal must still be used as a source of energy, even though it has been shown to contribute to acid rain. His solution is to support research that will find ways to cut dangerous high-sulfur emissions produced from burning coal.

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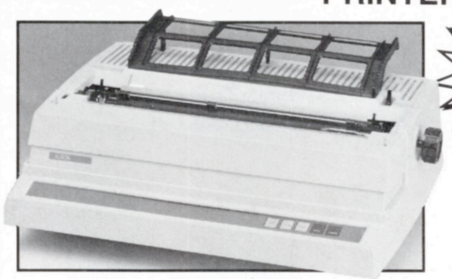

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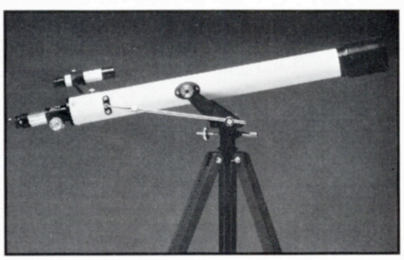

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Quizzical eccentricities:
Are you as mad as a great inventor?

GAMES

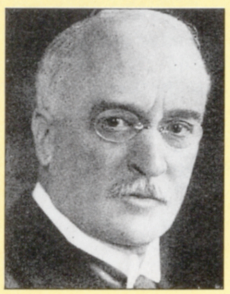
By Scot Morris

The light bulb, the telephone, and the phonograph are such ordinary parts of our lives that we take them for granted. Their creators, however, took *nothing* for granted. Eccentric individuals with peculiar visions of the world, they entertained ideas that others considered radical or just plain crazy, concludes Bryan Mattimore, a new-products consultant in Stamford, Connecticut.

"Great success comes only to those willing to risk great failure," says Mattimore, who has studied inventors' lives for a creative-thinking seminar he conducts.

Devising a multiple-choice test concerning inventors, Mattimore mixed their truly bizarre ideas with a few of his own. He gave *Omni*'s edited version to members of the Inventors Association of Connecticut (IAC) and to a group of gifted seventh graders. One point was awarded for each correct answer, with a maximum score of 12 points. The scores among IAC members ranged from 0 to 8, with an average score of 3.9. The students did better: The average was 4.4, with a low of 3 and a high of 6. What surprised us was the frequency with which the correct answer turned out to be the one considered least likely.

If you have the courage to risk failure, try this quiz. Mark +1 beside your first choice as the answer to each question, and −1 beside the one you think is most probably false. Then total your results: Give yourself one point for each correct answer; subtract a point every time your "false" choice turns out to be the right answer.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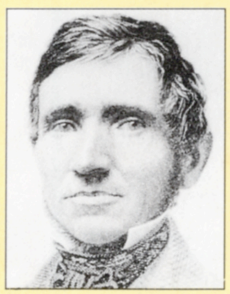
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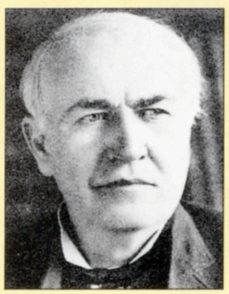
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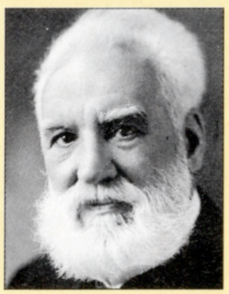
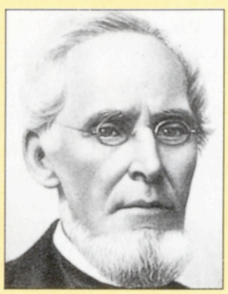
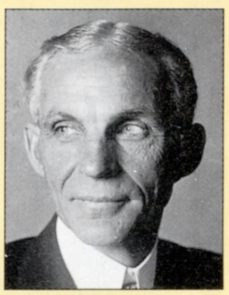

BELL


BORDEN

EASTMAN

HALL


FORD

Of 34 IAC members who were asked to score their choices for each question in the same way, only 14 registered positive totals. The average was just a little better than −1. The best score was +5; the worst, −7. If you score lower, don't be ashamed. Perhaps your thinking is so eccentric, so far beyond the ordinary, you might have what it takes to be one of "those crazy inventors" yourself!

GREAT ECCENTRICITIES

1. As part of his grooming regimen, Henry Ford would:
a) add particles of sand to his toothpaste to increase its abrasive, tartar-removing qualities.
b) dye his hair with rusty water.
c) keep the balls of his feet soft by applying a coating of his own saliva to them nightly.

2. Thomas Edison proposed to his second wife by:
a) recording the marriage proposal on his newly invented phonograph and playing it for her during a candlelit dinner.
b) tapping out the proposal in Morse code, from his hand to hers.
c) making a movie of himself proposing on bended knee.

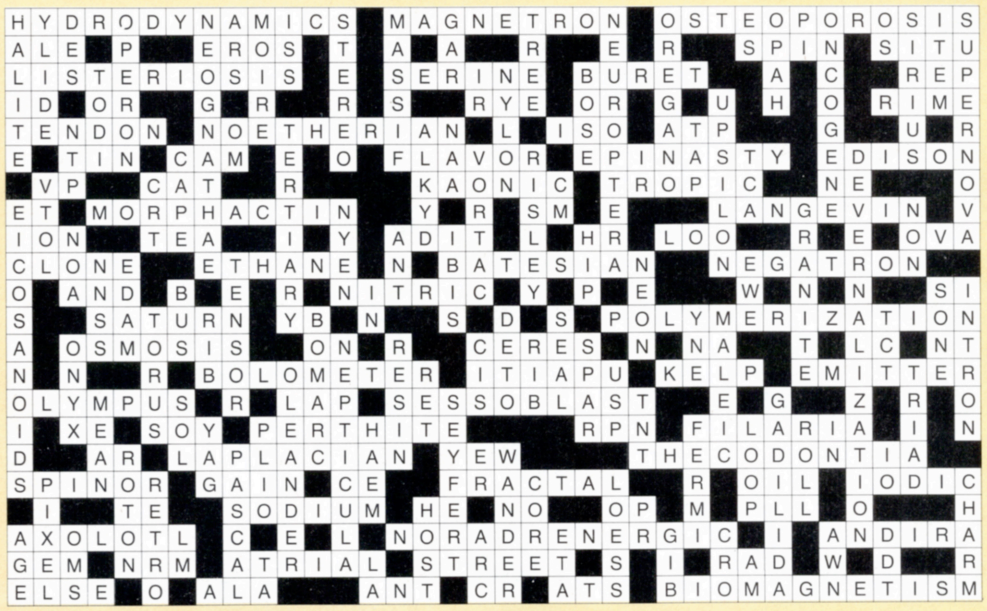
3. Because he thought it would benefit his health, Ben Franklin would:
a) walk barefoot through the mud, believing it helped pragmatic thinking.
b) drink water only from a glass container that had been left out in the sun for hours.
c) take "air baths" by sitting naked in front of an open window and inhaling deeply.

4. Nikola Tesla, who invented the alternating current (AC) motor, once tried to invent a device that:
a) diagnosed people's health by electronically reading their auras.
b) elicited memories when applied to various parts of the head.
c) photographed thoughts on the retina of the eye.

5. George Eastman, inventor of the Kodak camera:
a) was a supporter of the 13-month calendar.
b) took a photograph of himself every day from age thirty-one to seventy-two.
c) invented a camera that when swallowed by cows took pictures of each of their four stomachs.

6. As a health precaution, Alexander Graham Bell:
a) covered his ear with gauze every time he used the telephone.
b) covered the windows in his home to block out the harmful rays of the full moon.
c) drank his own urine.

7. Edison was convinced:


HYDRODYNAMICS MAGNETRON OSTEOPOROSIS
ALE P EROS T A A R E R SPIN SITU
LISTERIOSIS E SERINE BURET A C REP
ID OR G R R S RYE OR G U H O RIME
TENDON NOETHERIAN L ISO ATP G U R
E TIN CAM E O FLAVOR EPINASTY EDISON
V P CAT R KAONIC TROPIC NE O
ET MORPHACTIN Y R SM E LANGEVIN V
ION TEA I Y ADIT L HR LOO R E OVA
CLONE ETHANE N BATESIAN NEGATRON
O AND B E R NITRIC Y P E W N N SI
S SATURN YB N S D S POLYMERIZATION
A OSMOSIS ON R CERES N NA T L C NT
N N R BOLOMETER ITIAPU KELP EMITTER
OLYMPUS R LAP SESSOBLAST E G Z R O
I XE SOY PERTHITE RPN FILARIA I N
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AXOLOTL C E L NORADRENERGIC I ANDIRA
GEM NRM ATRIAL STREET S I RAD W D R
ELSE O ALA ANT CR ATS BIOMAGNETISM

a) the Germans were using a "thought ray" during World War I to control President Woodrow Wilson's mind.
b) there were submicroscopic entities, or "little people," living in his brain.
c) he would someday invent a pair of "electronic goggles" to see into the future.

8. Vulcanized rubber inventor, Charles Goodyear:
a) considered making rubberized water beds for the ill.
b) proposed that newspapers be printed on rubber.
c) foresaw rubber parasols, rubber carpets, rubber blackboards, and even rubber bank notes.
d) all of the above.

9. Milkman Gail Borden:
a) had his tomb built in the shape of a condensed-milk can.
b) tried to sell condensed cow's blood as an ingredient in a salad dressing.
c) filled a public pool with milk to promote the idea that milk baths were good for the skin.

10. Charles Hall, who invented a practical way to produce aluminum, theorized:
a) a daily diet of seaweed could cure asthma.
b) aluminum eyeglass frames would enable the wearer to better predict the weather.
c) tobacco had snuffed out creative impulses during the previous 200 years.
d) all of the above.

11. Alexander Graham Bell:
a) tried to get his dog to talk by teaching it to growl as he manipulated its mouth.
b) charted the vibrations of his own voice on a piece of smoked glass by talking into a mounted ear with a piece of hay stuck in it.
c) recommended that aspiring inventors reflect a *smell* and measure its velocity of transmission.
d) all of the above.

12. Hating unnecessary suffering, Rudolf Diesel once invented:
a) an ammonia bomb that would confuse the enemy instead of killing him.
b) an adhesive-wire fence as an alternative to barbed wire.
c) a bog-creating mud plow to trap soldiers in the mud instead of shooting them.

Answers appear below.

CROSSWORD RESULTS

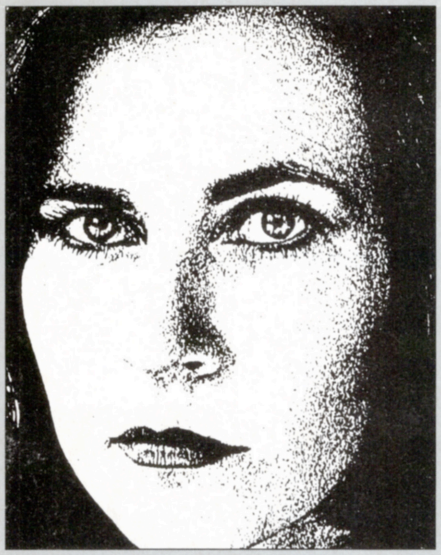
The entries for last November's *Omni*–McGraw Hill Crossword Puzzle poured in. After each was reviewed, the grand prize- and three first prize-winners were randomly selected from an impressive 24 perfect scorers. The fact that the clue for number 120 across was incorrectly labeled 118 had little effect on our readers' ability to complete the puzzle (left), based on information in our grand prize, the sixth edition of the *McGraw-Hill Encyclopedia of Science and Technology*.

Our grand prize goes to Donnell Tinkelenberg of Santa Rosa, California. Our three first prize-winners—Roger J. Dornberger of Saline, Michigan; John and Amy Pearson of Austin, Texas; and William Sales of Marion, Illinois—each receive the *McGraw-Hill Concise Encyclopedia of Science and Technology*, worth $98.50.

We originally announced there would be *five* runner-up prizes, but we think anyone getting a perfect score deserves to be rewarded. So each of the following receives $25: Sheila Bishop, Youngstown, Ohio; David Czarnetzki, Belgrade, Montana; Cynthia Destaffany, Friday Harbor, Washington; Walter Dragon, Bristol, Wisconsin; Suzy Lewis Ewell, Colorado Springs; David Fowler, Gaithersburg, Maryland; Cindy Garletts, Bridgewater, Virginia; Rita Garletts, Harrisburg, Virginia; Terry Garletts, Bridgewater, Virginia; Maude Kerby, Midlothian, Virginia; James MacDonald, Elkton, Maryland; Glen Martin, Eau Claire, Wisconsin; Thomas Reynolds, Tampa; Don Rickenbaugh, Energy, Illinois; Michael Roa, Sebastopol, California; Eric Tentarelli, Andover, Massachusetts; Ann Thomas, Ames, Iowa; Keith Thomas, Rapid City, South Dakota; Je Yackovich, Naperville, Illinois; Richard Youngblood, St. Louis, Missouri.

ECCENTRIC ANSWERS

1-b, 2-b, 3-c, 4-c, 5-a, 6-b, 7-b, 8-d, 9-a, 10-c, 11-d, 12-a



LAST WORD

By Kathy Thornock

"During the infamous Spinach Inquisition, vegetable vigilantes proclaimed all Veg-O-Matic manufacturers guilty of crimes against agronomy. They were sliced, diced, and julienned by their inventions."

Breathless, Cory McIntosh crouches behind a stack of pallets in Storage Shed Number 6 of the Cynica apple-packing plant. He clutches his rifle close to his body as his eyes search the building for a hiding place. McIntosh can hear the enemy. He knows that they feel none of the fear he is experiencing. For them, this is just another routine extermination.

"We always get our man." That is their motto, McIntosh thinks gloomily. *Well, at least they chose an appropriate place for it to end—right here where it started.*

McIntosh still remembers that day, 20 years ago, when his father, Jonathan McIntosh, unbolted the door to Shed Number 6 and drove his Heister in to get a bin of Granny Smiths.

He never returned.

They found him that evening—cored, peeled, and impaled on his forklift. He had been smothered with brown sugar and rotisseried. McIntosh grimaces in anger as he recalls the headlines: KILLER APPLES SAUCE THE BOSS. Within hours, busloads of sensationalist reporters had swarmed into town, probing for disgusting renditions of the "Boxed Rebellion."

McIntosh hated them all, but most of all he hated the scientists. "It's their fault!" he mutters. "They just had to 'improve' nature. Ha! *Some* improvement."

The warehouse is quiet, but outside he can hear the apple commanders directing their troops. He hears the familiar crunch, crunch as they roll into attack formation. "There is no way I stand a chance against the entire Apple Corps," he groans. "I'm doomed."

Scientists had known that botanical engineering would alter plant life, but they had no idea that their experiments would result in the extinction of human life. At first everything went fine. Experiments in crossbreeding and gene splicing were successful. Then Green revolutionaries of the Eighties began experimenting with electroporation—the insertion of new DNA into plant cells. They created strong new superplants that were resistant to frost, heat, bugs, and herbicides.

Soon scientists were altering antisocial vegetation. Cactus DNA, inserted into corn kernels, was supposed to produce plants that wouldn't need irrigation. Unfortunately, Dr. I. M. Sporen pricked his finger and got blood on the electrogun just before delivering the transfusion. The result: commando corn.

Scientists knew they had a problem when maturing ears began shucking themselves. Soon, however, their prankishness turned to lawlessness. Without warning, maize militants seized the Corn Palace in Mitchell, South Dakota, and declared themselves the independent nation of Hominy. One particularly unruly band of oversize kernels established the Plant Liberation Organization (PLO), headed by an unkempt, wormy stalk of field corn named YesSir AreYouFat.

McIntosh knows that the apple guerrillas pursuing him were trained at PLO terrorist camps. "If only we had acted sooner," he says regretfully.

By the time people began to get worried, commando corn contracted the vital virus IDES (immunity to destructive environmental stimuli). Scientists aren't certain what causes IDES, although initial studies indicate there may be a correlation between IDES and long-term exposure to the lime used in tortilla factories. Within months an epidemic of IDES had spread throughout the plant kingdom.

A shout interrupts McIntosh's musings. "Come on out, McIntosh. We know you're in there." McIntosh recognizes the voice of Mr. Green Genes, the ferocious leader of the Rambo Reds.

"You'll have to come in and get me, mushface," he shouts.

"It will be easier on you if you come peacefully. I'd rather not do to you what we did to Juice Newton."

McIntosh flinches. "Barbarians."

His mind fills with gruesome pictures of the brutal Concord Grape Riots of 1990, in which bunches of inner-city street grapes killed, mutilated, and gang-graped thousands of Napa Valley residents.

Throughout the nation, renegade herbage wreaked havoc (which is messy and smells bad). It was rumored that fruit felons, jealous of human appendages, routinely looted battlegrounds, searching for arms and legs, which they stuffed into giant Ziploc bags.

Some people were particularly at risk from vegetable vigilantes. During the Spinach Inquisition, Veg-O-Matic manufacturers were proclaimed guilty of crimes against agronomy and were sliced, diced, and julienned by their own inventions. In California, rampaging Indian corn ambushed and scalloped Spuds MacKenzie, and gourmet herbal chefs popularized such exotic human entrées as Julia Child Flambé and Jane Fondue. Even in San Francisco's usually peaceful Chinatown, bean sprouts stir-fried vegetarians in communal woks.

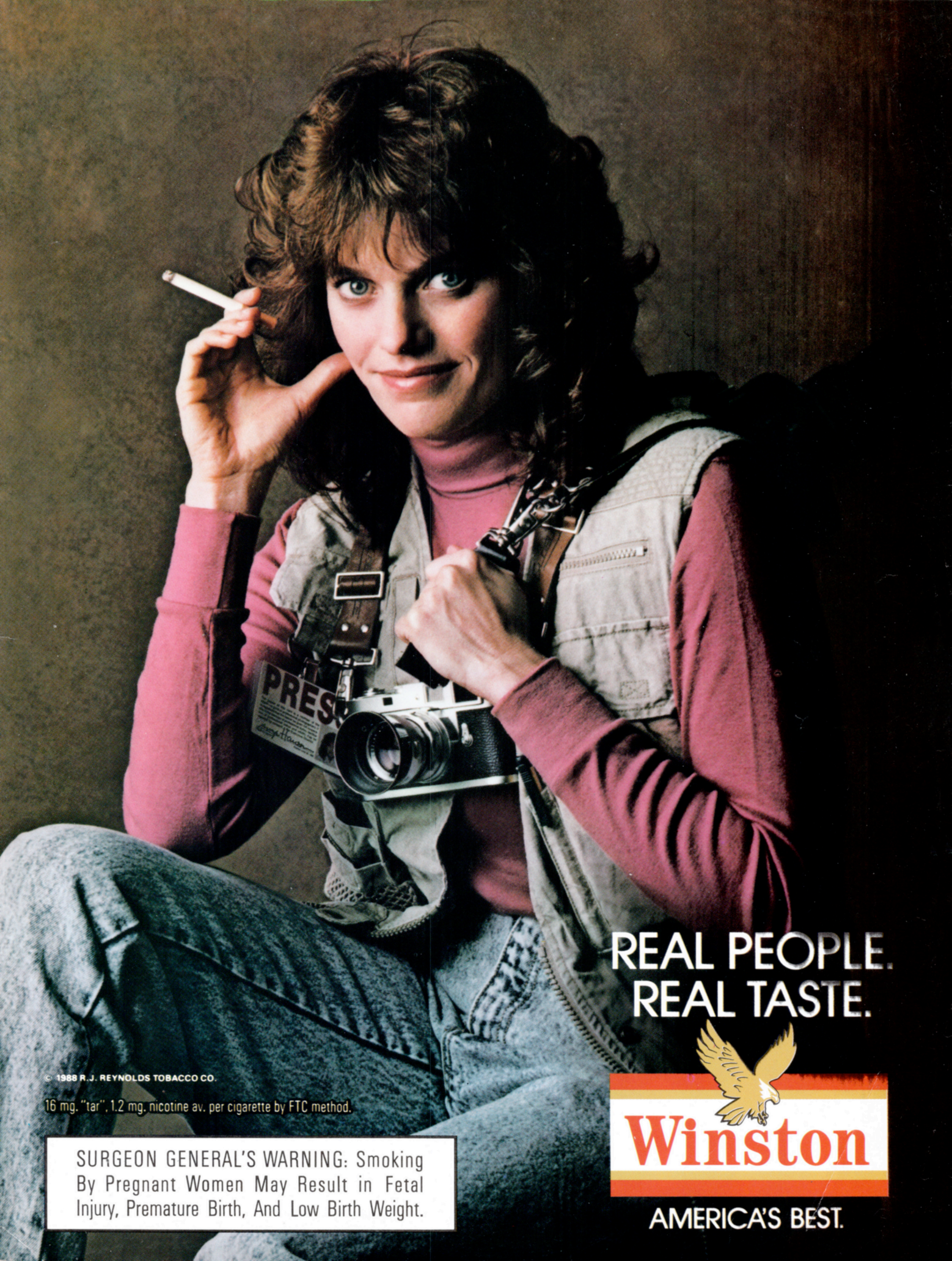
Despite his own predicament, McIntosh feels sorry for the vegetarians. Since the emergence of superplants, they were hunted by vegetables hungry for revenge. In Asia the entire brown rice population thrived on vegetarians smothered in soy sauce.

"You'll never take me alive!" he declares.

Suddenly he detects the sound of approaching helicopters. Above the noise, a voice calls out: "Stop! Stop! We have the ransom! Do not attack the warehouse."

Peeking from a crack in the door, McIntosh sees a man stepping out of the helicopter with two huge Ziploc bags. Despite the swirling dust, McIntosh recognizes Kernel Oliver North. He's come to swap arms for hostages.∞

Kathy Thornock lives in Wenatchee, Washington, which has a sign welcoming visitors to the apple capital of the world.



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